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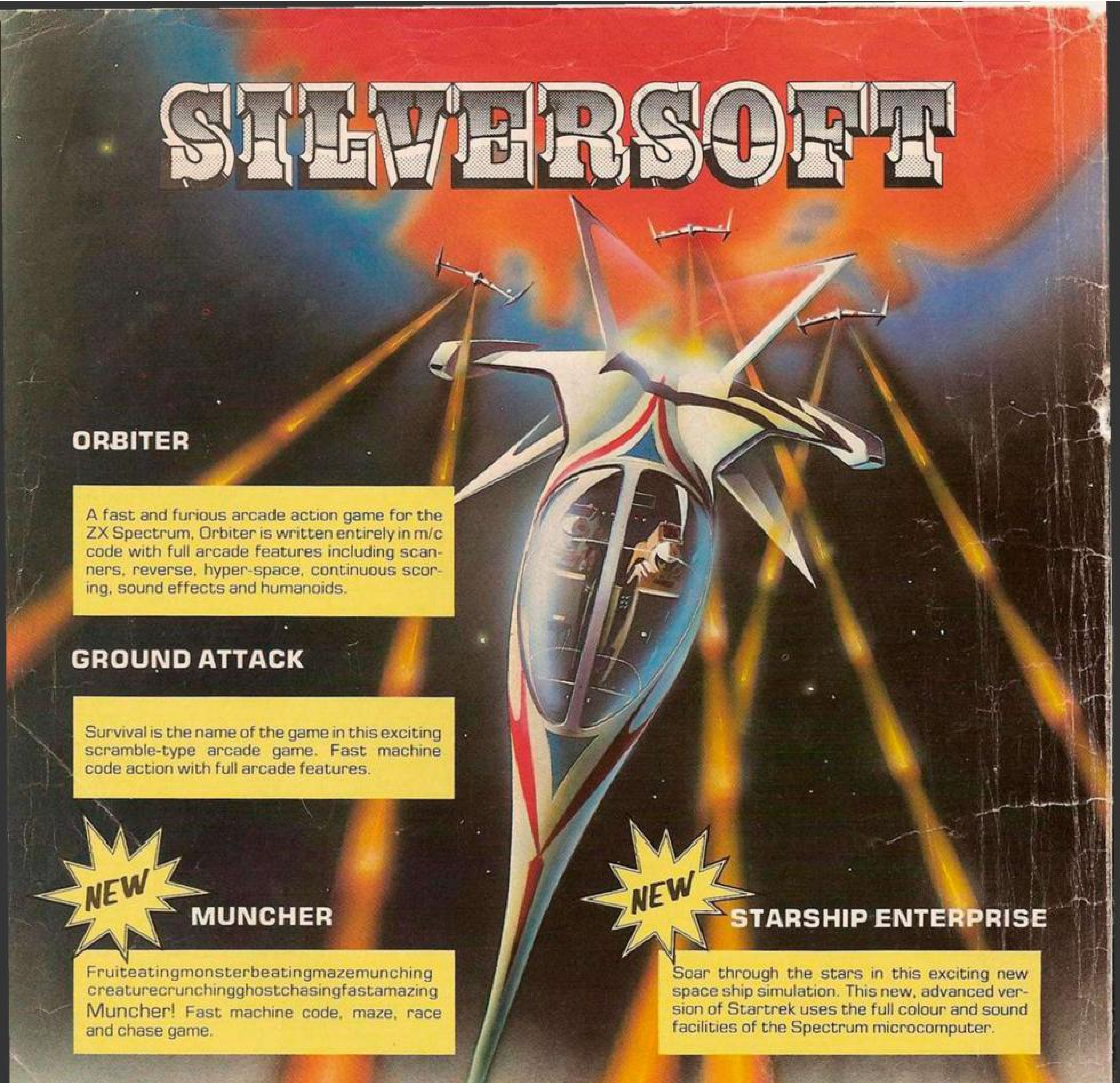
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EDITORIAL

ONCE UPON A TIME big expensive computers sat in offices and did serious jobs like the accounts and word processing, while little computers stayed at home and pushed lumps of coarse graphics around the screen in a parody of ping-pong. That was not quite as far off as the days when the princess still had to kiss the frog, rather than steer him across three lanes of alligators for a new high score, but it was a time when a computer knew its place: either in the office or in the home. Now that distinction is beginning to blur, and the home computer's increasing sophistication must be credited with a major role in bringing about the change.

By offering more features at ever-lower prices, home micros have made buyers and owners of "serious" systems expect more for their money. After all, put yourself in the shoes of the businessman who has just taken the first step into the unknown and bought a micro for his office. When he then discovers that his dear little nephew's BBC model B or Commodore 64 offers many of the features of the new office system but at a fraction of the cost, he will justifiably feel aggrieved. The businessman's growing awareness of the burgeoning home consumer market means that he will know that the technology in itself is not expensive and will bring him to ask why, when dressed up in a business micro's box, it should prove so costly.

But business computing also exerts a strong pull on the home market. As computer literacy grows, home users want more than just games. They want the option of turning their micros to serious applications such as word processing. That means they must be given real keyboards and mass storage. It is to that demand that manufacturers are just beginning to respond, as we show in this issue. Discs are moving down in price to within the reach of the home micro, and home machines like the Lynx are moving up to take advantage of features such as CP/M, which mean you will be able to run business software at home — or even use the same machine in both environments. If this trend continues, a new market will open for portables which are as entertaining as they are useful. Built-in mass storage might then be less important if a Modem could be incorporated to access outside databases.

It is no coincidence that both Acorn and Sinclair Research plan to release portable micros later this year. ■



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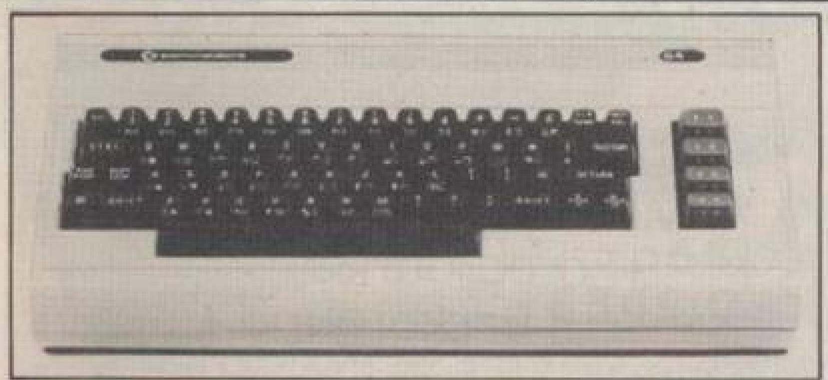


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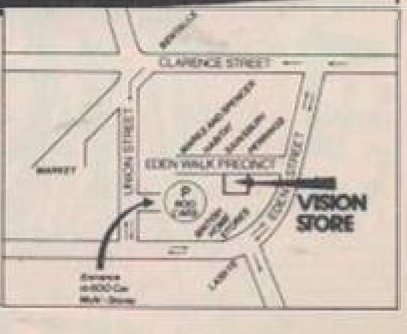
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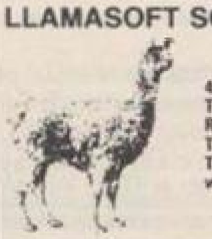
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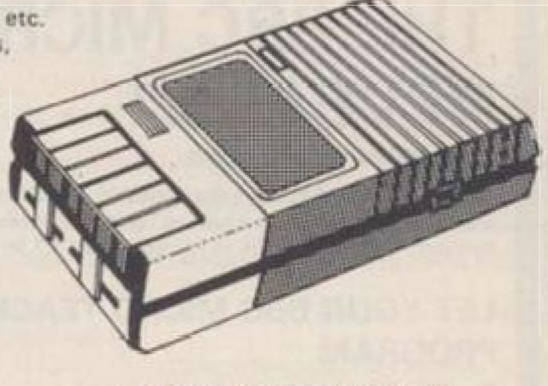
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Z5. **MAZOGS** "Just the sort of program to impress your friends" - *ZX Comp*. "A superb new concept" - *PCW*. Amazing graphic maze game. (Bug Byte). £8.00.

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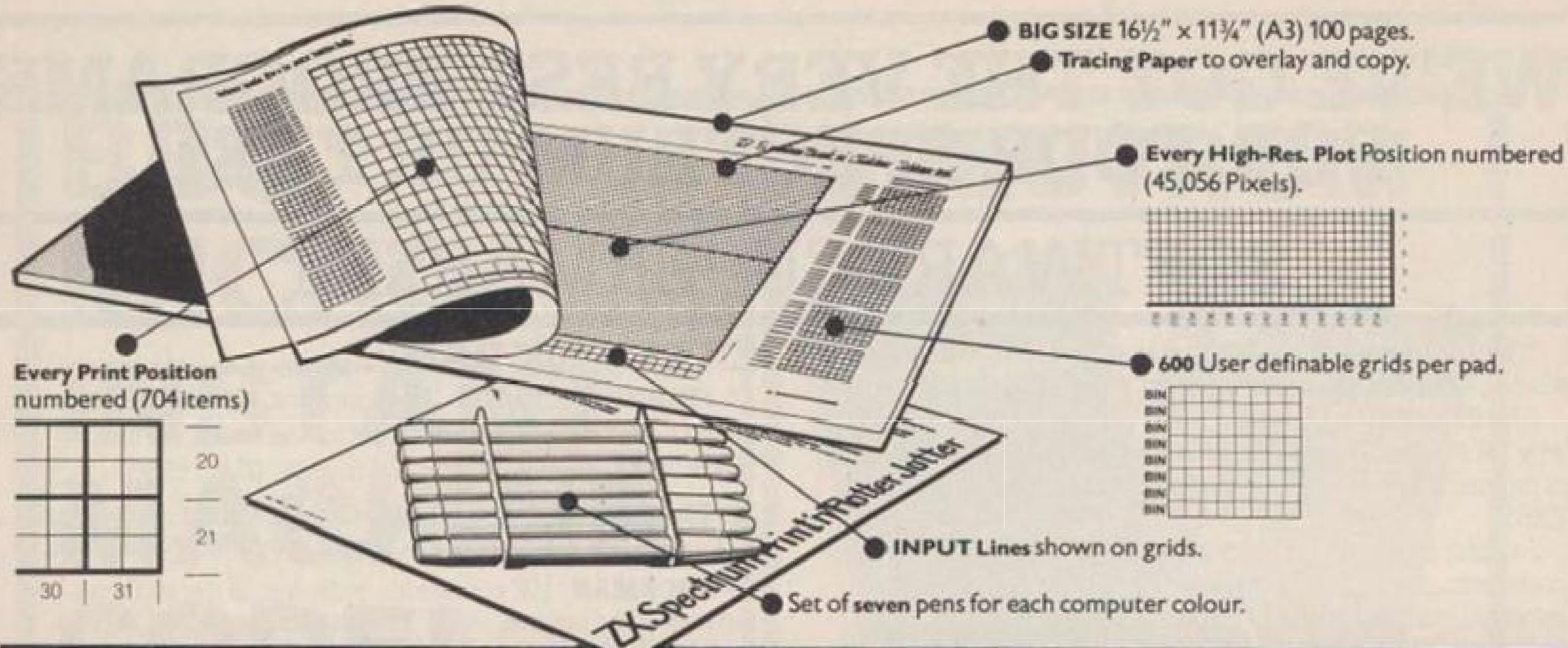
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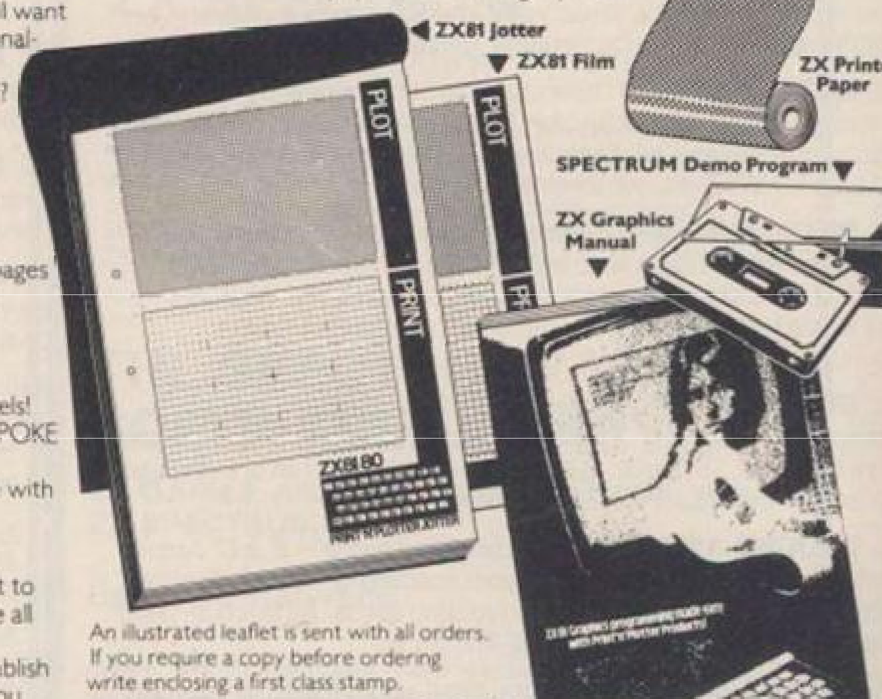
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ZX Spectrum
BLUE EDIT 1 ! DEF FN
RED CAPS LOCK 2 @ FN
MAGENTA TRUE VIDEO 3 # LINE
GREEN INV. VIDEO 4 $ OPEN #
CYAN 5 % CLOSE #
YELLOW 6 & MOVE
WHITE 7 ' ERASE
8 (POINT
GRAPHICS 9) CAT
BLACK DELETE 0 _ FORMAT
SIN Q <= PLOT ASN
COS W <> DRAW ACS
TAN E >= REM ATN
INT R < RUN VERIFY
RND T > RAND MERGE
STR$ Y AND RETURN [
CHR$ U OR IF]
CODE I AT INPUT IN
PEEK O ; POKE OUT
TAB P " PRINT ©
READ A STOP NEW ~
RESTORE S NOT SAVE |
DATA D STEP DIM \
SGN F TO FOR {
ABS G THEN GOTO }
SQR H ↑ GOSUB CIRCLE
VAL J − LOAD VAL $
LEN K + LIST SCREEN $
USR L = LET ATTR
ENTER
CAPS SHIFT
LN Z : COPY BEEP
EXP X £ CLEAR INK
LPRINT C ? CONT PAPER
LLIST V / CLS FLASH
BIN B * BORDER BRIGHT
IN KEY$ N , NEXT OVER
PI M . PAUSE INVERSE
SYMBOL SHIFT
BREAK SPACE

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Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

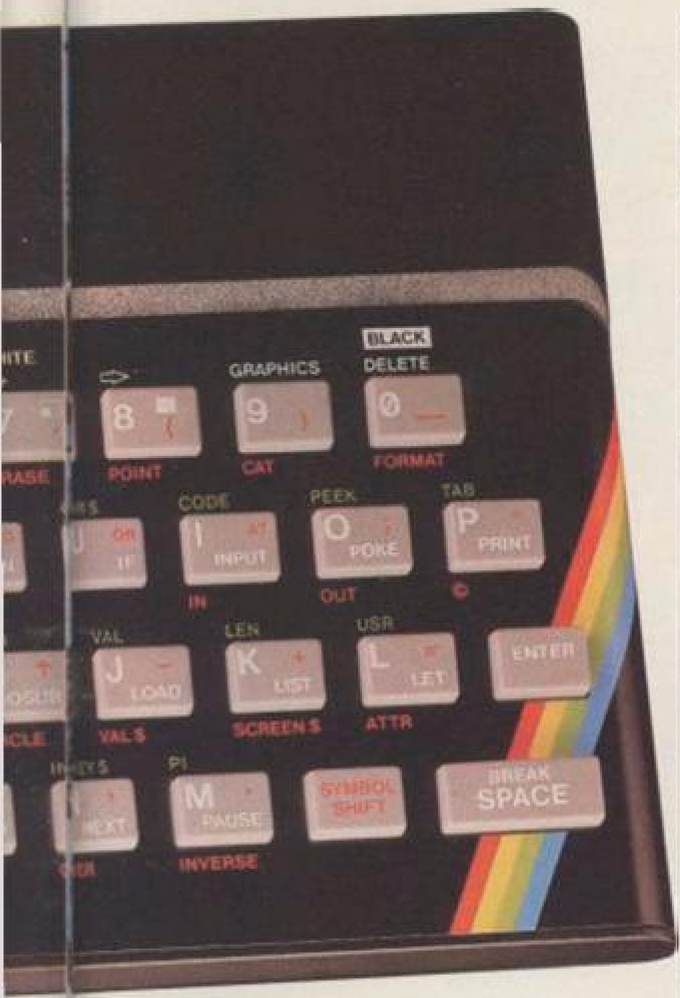
There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
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ZX Spectrum software on cassettes–available now

The Spectrum software library is growing every day. Subjects include games, education, and business/ household management. Flight Simulation...Chess...Planetoids... History...Inventions...VU-CALC...VU-3D ...Club Record Controller...there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS. Tel: Camberley (0276) 685311.

The ZX Printer–available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set–including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive–coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.





How to order your ZX Spectrum

BY PHONE–Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST–use the no-stamp needed coupon below. You can pay by cheque, postal order, Barclaycard, Access or Trustcard.

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	Sinclair ZX Spectrum–48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
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Address

YOC 902

FREEPOST–no stamp needed. Prices apply to UK only. Export prices on application.

Sinclair ZX Spectrum–technical data.

Dimensions

Width	233 mm
Depth	144 mm
Height	30 mm

CPU/ memory

Z80A microprocessor running at 3.5 MHz. 16K-byte ROM containing BASIC interpreter and operating system.

16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

Keyboard

40-moving-key keyboard with full upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes, and 21 user-definable graphics characters. All keys have auto repeat.

Display

Memory-mapped display of 256 pixels x 192 pixels; plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/ speaker.

Graphics

Point, line, circle and arc drawing commands in high-resolution graphics.

16 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive–or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text, similarly. Colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red, magenta, green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

Screen

The screen is divided into two sections. The top section – normally the first 22 lines – displays the program listing or the results of program or command execution. The bottom section – normally the last 2 lines – shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.

Mathematical operations and functions

Arithmetic operations of +, –, ×, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generator, and pi.

Numbers are stored as five bytes of floating point binary – giving a range of $+3\times10^{-39}$ to $+7\times10^{38}$ accurate to $9\frac{1}{2}$ decimal digits.

Binary numbers may be entered directly with the BIN function. =, >, <, >=, <= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

String operations and functions

Strings can be concatenated with +. String variables or values may be compared with =, >, <, >=, <=, <> to give boolean results. String functions are VAL, VAL$, STR$ and LEN. CHR$ and CODE convert numbers to characters and vice versa, using the ASCII code.

A very powerful string slicing mechanism exists, using the form a$ (x TO y).

Variable names

Numeric – any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).

String – A$ to Z$.

FOR-NEXT loops – A-Z.

Numeric arrays – A-Z.

String arrays – A$ to Z$.

Simple variables and arrays with the same name are allowed and distinguished between.

Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

Expression evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

Cassette interface

The ZX Spectrum incorporates an advanced cassette interface. A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, title, length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving to confirm successful saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables names coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading.

The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

Expansion port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives.

IN and OUT commands give the I/O port equivalents of PEEK and POKE.

ZX81 compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows.

FAST and SLOW: the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

SCROLL: the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

UNPLOT: the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

Character set: the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

ZX81 programs may be typed into the ZX Spectrum with very little change, but may of course now be considerably improved. The ZX Spectrum is fully compatible with the ZX Printer, which can now print out a full upper and lower case character set, and the high resolution graphics; using LLIST, LPRINT and COPY. ZX81 software cassettes and the ZX 16K RAM pack will not operate with the ZX Spectrum.

sinclair

ZX Spectrum

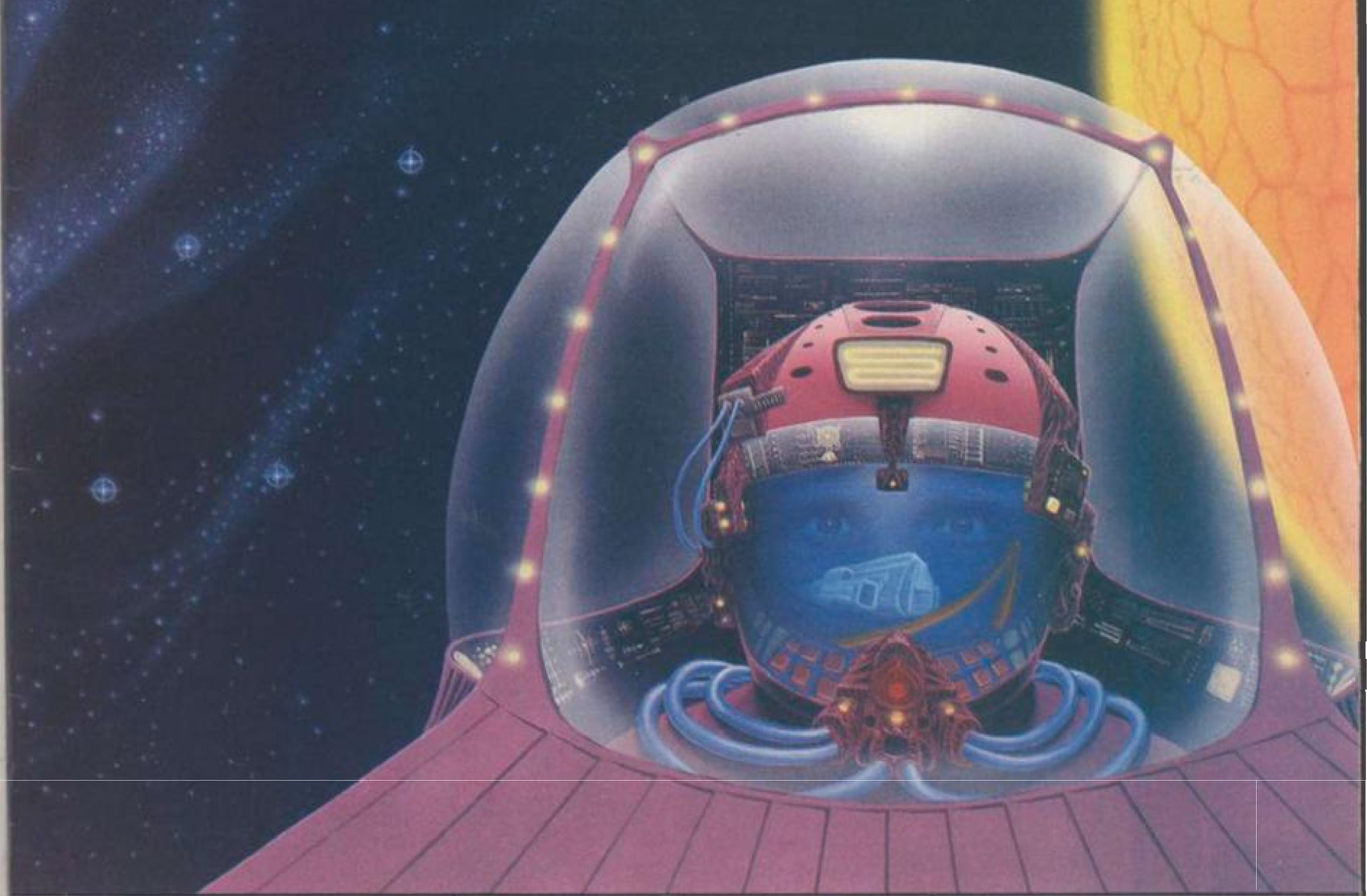
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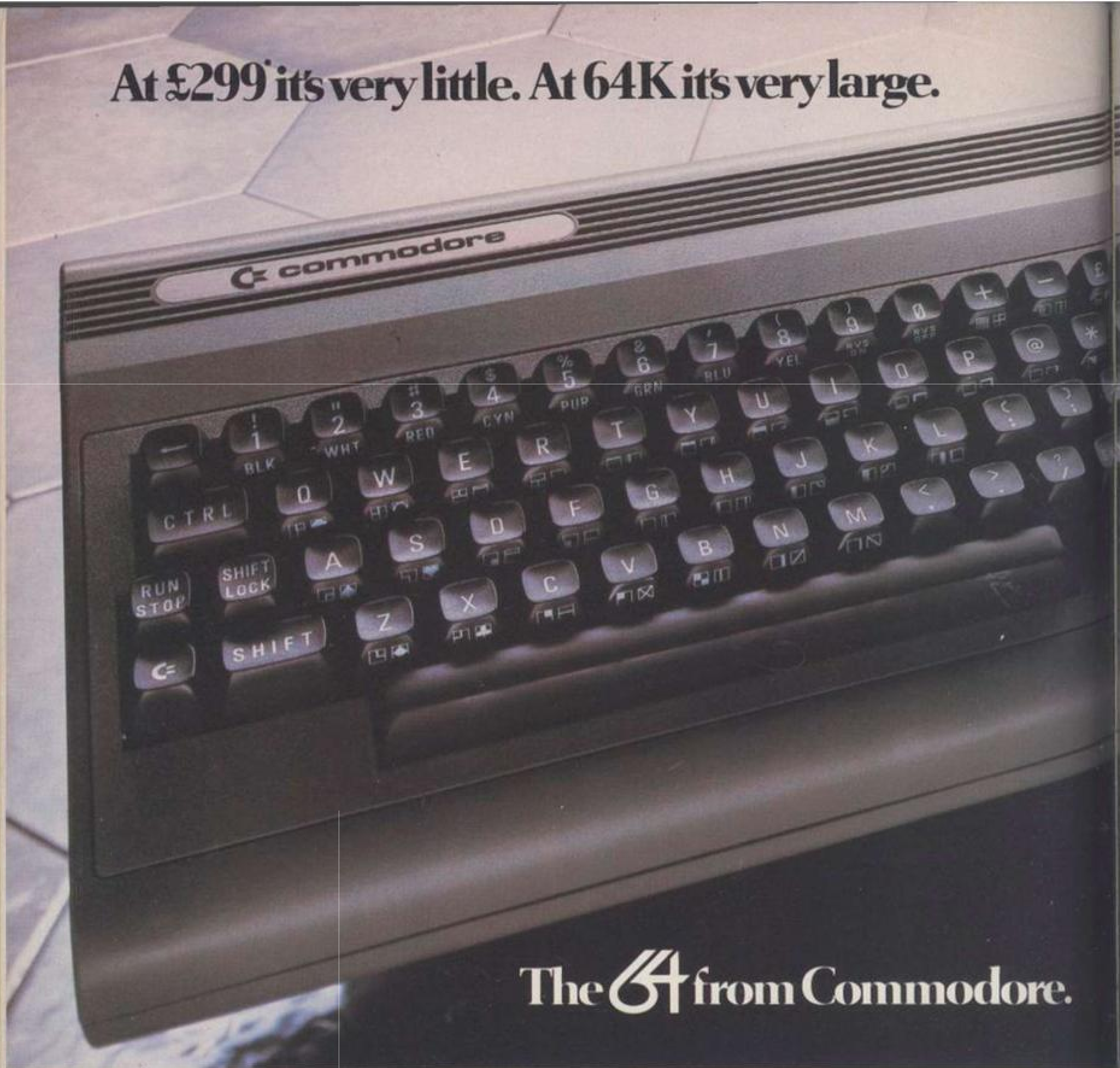
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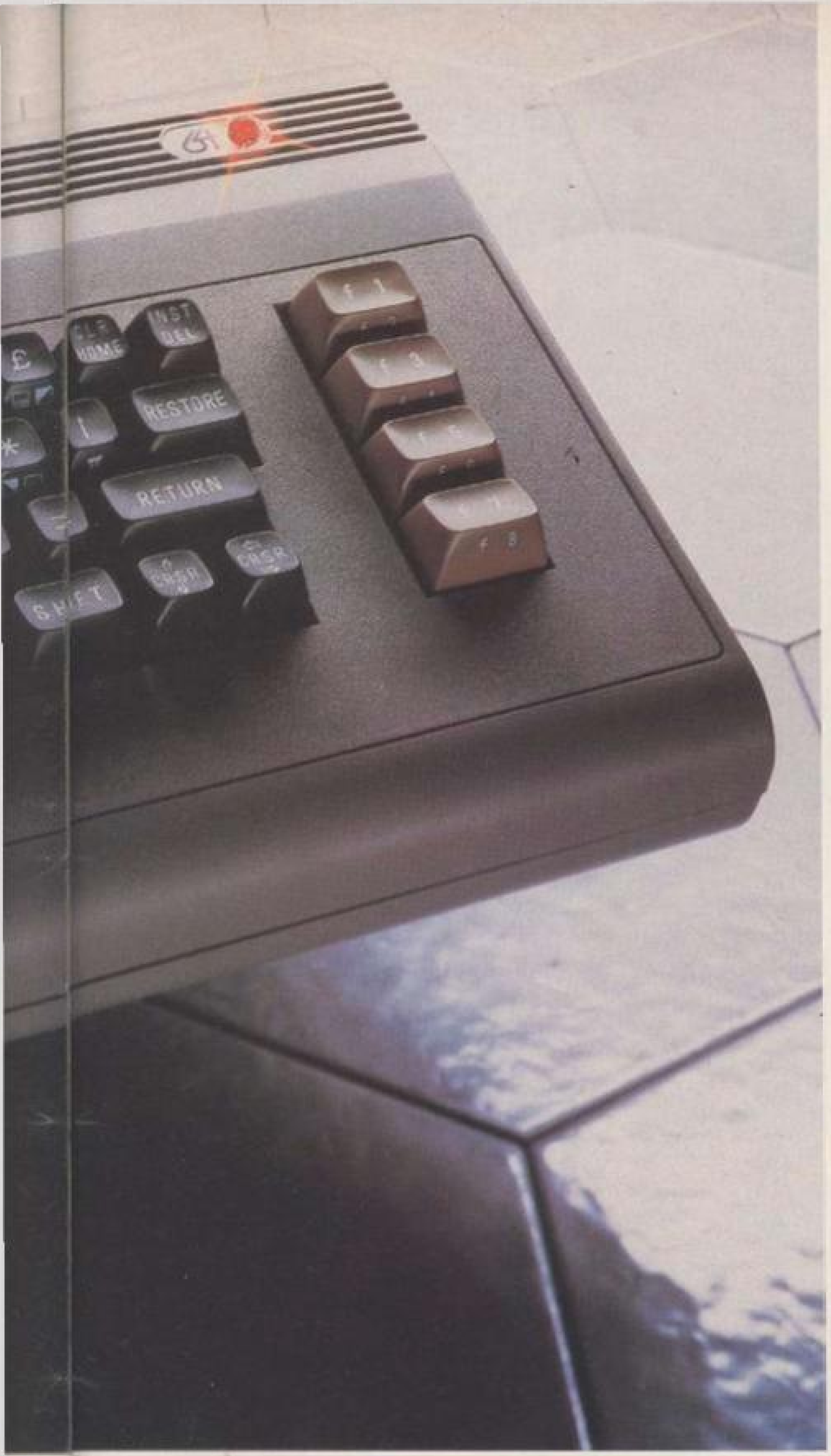
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YOUR LETTERS

DRAGON SAVE

Having had many initial problems with program crashing on my Dragon 32 and Ferguson tape, I would like to pass on this tip to your readers.

It is no use relying on the five-pin DIN-plug to jack-plug lead supplied by Dragon for use with the machine to Save and Load programs. To obtain reliable saving and loading, a five-pin DIN to five-pin DIN lead is required, this being coupled from the DIN socket on the Dragon to the DIN socket on the Feguson cassette. The tone setting on the Ferguson should be set to maximum, the volume setting to half-way.

Using the method has only one drawback, as it loses the Dragon's remote control feature.

It is therefore important that to save a program users have the cassette running before the CSave command is entered and conversely the C.Load command entered and S commenced before the Play button is pressed.

The principle behind the use of the DIN lead is that it gives a better impedance match, and therefore a better yield.

N J Peake,
Berryhill,
Stoke on Trent.

BREAKER

With reference to Gino Cracins' program in Software File — see December 1982 — which will break any ZX-81 program upon loading, there is a much simpler way to achieve this, because the routine is already in the ROM. Just type:

```
FAST (N/L)
RAND USR 836(N/L)
```

The waiting-to-load pattern will appear on the screen. Start the tape recorder. When the program has finished loading, an error message of C/O will appear. Ignore this, then treat the program as a normal one: type List.

T J Rogers,
Newbury,
Berkshire.

VIC COLOUR

I own a Vic-20 and personally think that it is a great machine but one of its minor failings is its colour display, which tends to be rather dull. However, this can be rectified in a few moments after a minor adjustment.

Remove the three screws holding the top half of the machine — the keyboard — and gently take it out. Test it face down, on the keys. Facing you, nearest the video-audio DIN socket there are two light-blue plastic screws with Phillips-type heads. Plug in the Vic and switch on TV as normal.

The right-most plastic screw, the one nearest the video-audio DIN socket should be turned very slowly clockwise.

You will immediately notice a great improvement in clarity and brilliance. Colour can also be adjusted using the TV's own colour controls in conjunction with the turning screw to reach the desired effect.

Replace unit keyboard carefully. Although removing the unit is not something that Commodore would approve of, if done properly it only takes a few minutes.

Des Taylor,
Beckenham,
Kent.

LONG MEMORY

A point that all owners, and prospective owners, of Dragons should note is that they have over 29K of user memory available if they ask the beast to give it to them. The default values leave only about 26K on offer but if, after power-up, you type in PClear 1 and then request ?Mem you will be told 29127, which is nice to know.

A colleague of mine has a Dragon that was hatched slightly earlier than mine, and he reports that he needs to type in PMode 0,0 to get the machine to accept the command to free those extra graphics pages for other use. Even though his machine is in that mode by default, it needs to be told it is! Perhaps some changes have been made to the ROM. If you have gone through PClear 1 you need to remember to go through PMode and PClear statements of the correct value before running specifically graphics-orientated programs; otherwise you will get FC errors thrown at you.

I have not yet found a use for those 29K+, as I am still at the novice stage of Dragon taming. However I am sure it could be valuable in terms of data and file handling and it surprises me that no reference is made to the possibilities in the manual, nor has it been mentioned by other commentators as far as I am aware.

It points up the need for somebody to produce some decent documentation on the machine as I believe that at present a great deal of its potential is unrealised. The books on the 6809 originating in the USA are both overdetailed for my purposes and too darned expensive!

I should also point out to potential computer purchasers, with the sort of brain-ache that I developed before making my decision, that the routine above makes many of the comparisons between machines entirely specious; after all Commodore will charge you a sum of about £30 for an extra 3K of user RAM.

Stephen Mummery,
Bury St. Edmunds,
Suffolk.

SAINT JUDE

I have been one of the many ZX-81 owners for over a year now. Until last week I was also one of the many ZX owners who had never managed to load a commercial software tape successfully. I had tried two different tape recorders, one normal and one computer-compatible, mains supply and battery, and even a prayer to Saint Jude — I hear lost causes are her speciality.

I was on the point of converting my ZX-81 into a short-range ballistic missile, when a freak accident changed my fortune. I left the machine plugged in overnight and my two-year old child engaged the Fast Forward button on the tape recorder while I was at work.

In a frenzy of panic I hurled the nearest tape into the machine and loaded. The signal on the screen still appeared normal but to my horror came up with the report O/O. And lo!, there it was: *Your Computer's* flexidisc program. Since then every program that I have offered has loaded without so much as an adjustment. Could this have had anything to do with the slowing down of the tape deck and therefore the computer finding it easier to accept the signal? Meanwhile to all those ZX-81 owners out there. Do not despair with your machine, just give it some stick!

I Harrison,
Slough,
Berkshire.

DISPLAY FILE

Two errors were printed in the December issue in Your Letters. Patrick Couser claims to have found location of the display file in a 16K ZX-81. First error: his letter states an address of 49340. You can not use addresses greater than 32768. If the address is higher than this, the ZX-81 effectively subtracts 32768; that is Peek 32769 equals Peek 1, Peek 32770 equals Peek 2. His value of 49340 is the same as 16572. Second error: the screen starting and finishing addresses can only be at the locations quoted if a short program is sitting in the ZX-81. The screen area always starts directly after your program area. Use a longer program and the screen area would be higher up in the memory. This is not a problem: the Sinclair manual quotes the system variables 16396 and 16397 as the pointers to the Display File Start — the screen area. In any program if you include a line thus:

```
LET Z = PEEK 16396 + 256*PEEK
    16397 + 1
```

then Z will hold the start address of the screen area. Note: the +1 is added at the end, since the first character in the display file is a character 118 — Newline character — and must not be altered. Try these examples to prove the point: Enter the previously-mentioned Let Z etc, as a direct command into an empty ZX-81. Then enter the following direct commands:

```
POKE Z,23
```

This will Poke a * in top left hand corner of the screen.

```
POKE Z + 31,23
```

will put an * in the top right-hand corner of the screen. Caution: the end of each line in display file is a 118 Newline character which must not be altered. You must allow for this if Poking the screen area.

```
POKE Z + 32,23
```

will most definitely casue the ZX-81 to crash. Try POKE Z+34,23 and you will Poke a * on to left-hand position of second line. Just in case you haven't realised, you simply add 33 to Z to go to a lower line. For example, to Poke a * to centre of the screen add 330 to get to centre line, and add 16 to get to centre column. Try:

```
POKE Z + 346,23
```

In Software File, the List Self Starter claims to be a method of stopping games which self-start and cannot normally be listed. It stated that Poke 16389,127 followed by New Newline before Loading would do this. 16389 is the pointer to RAMtop. It claimed this method enabled ZX Chess to be stopped. Whilst it possibly stops this game, it most definitely will not stop all games. This method simply reduces RAMtop such that there is insufficient memory for the game to Run. To stop games say of only 5K, you'd need to spend several weeks trying to decide the appropriate value to reduce RAMtop down to such that the game can Load but not Run.

G A Bobker,
Bury,
Lancashire

A CAUTION

May I add further point to the Sinclair saga. Like Mr Keevy — December 1982 — I got weary, hearing the same, regular extension of delivery forecast and finally cancelled my order at the end of August, by phone and following letter.

I heard no more of the matter until I received my November Access statement. This contained a debit in favour of Sinclair Research, dated October 19th. No Spectrum has been delivered, there has been no word from Sinclair and I have never signed any authorisation for Access payment, since the original order was by phone.

The answer would appear to be: warn the credit card company as well as cancelling with Sinclair, though in my case I have ended up closing my Access account and am currently trying to get them and Sinclair to sort out the balance.

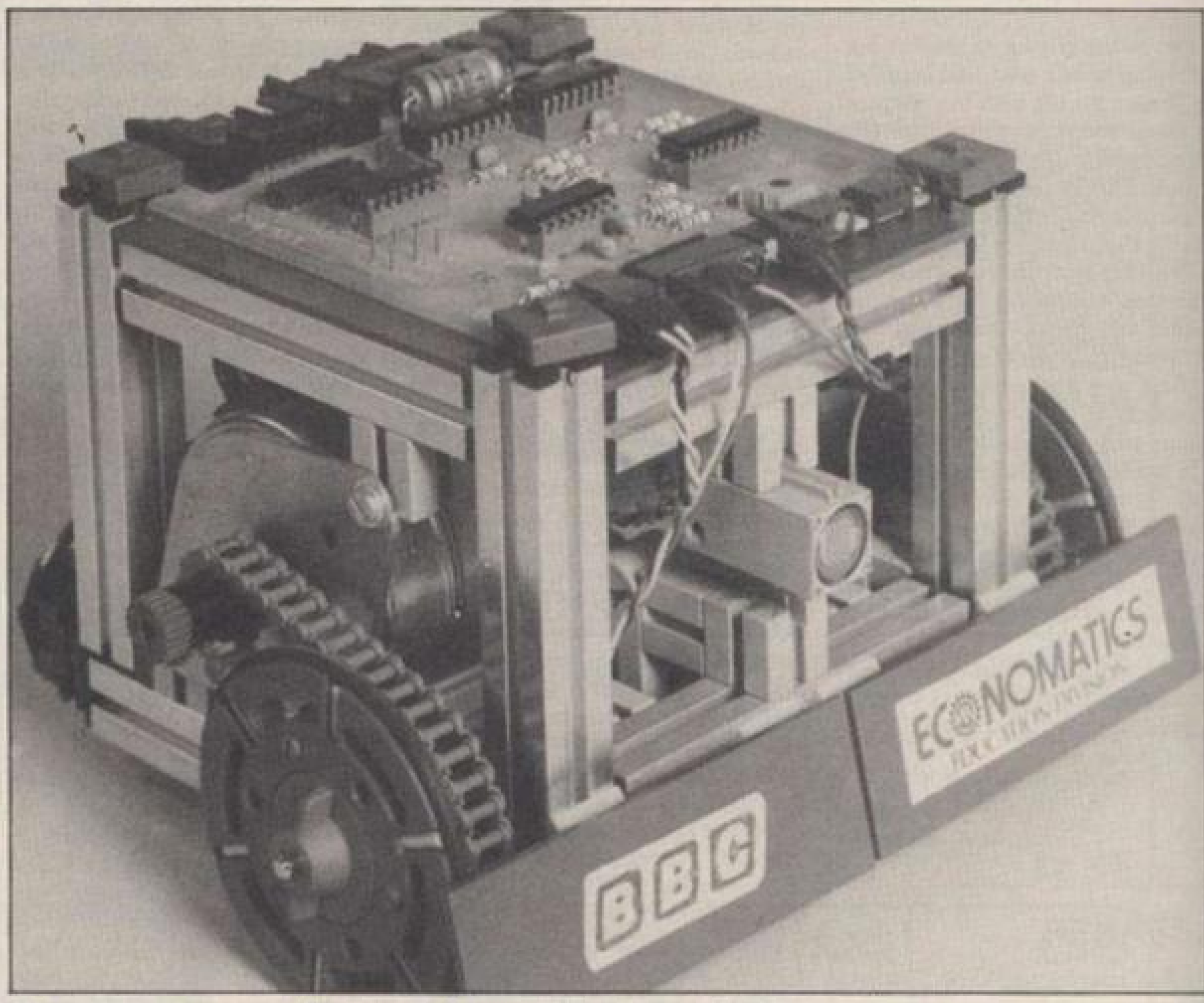
R K Davis,
Silverdale,
Lancashire. ■

It came from outer Handsworth — the £150 BBC robot buggy crawls into the classroom

ANOTHER FRUIT of the Computer Literacy Project is the BBC Buggy developed for the BBC by the Microelectronics Education Programme. The Buggy is a three-wheeled precision vehicle which operates from a BBC model B microcomputer. Described as a "programmable robotic device" the vehicle is driven by two stepper motors. It contains sensors which can detect light, and collisions, and there is also an infra-red transceiver underneath capable of reading bar-codes or following a line.

The device has been produced primarily for education. A series of graded programs is supplied with the package designed to demonstrate the nature of programmable control using the wehicle in an imaginative manner. Future developments will include a pen-up, pen-down mechanism.

The Buggy will be sold as a contruction kit complete with software, circuit boards, stepper motors and control cables. A screwdriver is the only tool required to assemble it. The price will be around £150 and it will be available in March from Economatics, 40 Orgreave Crescent, Dore house Industrial Estate, handsworth, Sheffield S31 9NQ.



YOUR COMPUTER TOP 20

Game	Company	Machine
3D Defender	J K Greye	ZX-81
Star Trek	Macronics	ZX-81
Gulpman	Campbell Systems	Spectrum
Black Crystal	Carnell Software	ZX-81
Amok	Audio-genic	Vic-20
Time Gate	Quicksilva	Spectrum
Trader	Pixel	ZX-81
Mazogs	Bug-Byte	ZX-81
Winged Avenger	Work Force	Spectrum
Hopper	Rabbit Software	Vic-29
Chess	Bug-Byte	BBC
Starwars	Audio-genic	Vic-20
Star Raiders	Atari	Atari
Pac-Man	Atari	Atari
Scramble	Quicksilva	ZX-81
Star Trek	Salaman-der	Dragon
Escape	New Generation	Spectrum
Submarine Commander	EMI	Atari
Space Walk	Bug-Byte	BBC
Pimania	Automata	ZX-81
Ghost Attack	Dragoh	Dragon

Barton sleuths use micro to deflate £2 million fraud claims

WHEN POLICE SWOOPED on Oxford's "scroungers" last year and smashed what they claimed was a multi-million pound fraud, they could hardly have expected that a micro-computer would come to the aid of the claimants.

While banner headlines told how Operation Major had smashed a £2 million social security fraud the Claimants Defence Committee claimed that the facts were rather different and asked a local community centre, the Barton Project, to use their computer to keep track of the cases as they appeared in court. The Barton Project went further and developed a 40K welfare rights program in Basic. This can tell claimants what they should be receiving and is designed to be used by any community centre which could afford a home computer like the Lynx or Commodore 64.

The analysis of the cases showed the total fraud to be less than £63,000 rather than over £2 million and according to Mike Noble of the Barton Project some who were convicted were owed more by the DHSS than they were alleged to have fraudulently claimed.

Mike Noble wrote the welfare rights program in Reasearch Machines Basic but has deliberately designed it to make it easily translatable for any home computers with 40K of spare memory. Mike Noble points out that "The complexity is in the rules themselves and reducing them to If . . . Then statements, not in the program itself. The average games program in the back of *Your Computer* has more complicated Basic."

Anyone using high resolution graphics on the BBC model B is limited to a maximum of 8K RAM to program in. Modes 0, 1, and 2 take up 20K of the available 32K and the operating system consumes a further 3.5K which it needs for work space. Acorn's answer to this memory shortage in the Tube; a 1MHz data bus which permits the model B to be connected to a second processor. From the end of March two eight-bit processors, a 6502 and a Z-80, will be on sale for £195 each. Both supply a further 64K RAM of which 48K will be available to the user. At a later date Acorn is going to release a 16-bit processor with the capacity to address a massive 16 Mbytes of RAM. Adding a second processor should result in significant improvements in processing speed. Since the second processor will take over the task of interpreting and running programs it will leave the first processor free to handle all input/output operations such as writing to the screen or scanning the keyboard.



Commodore compiler

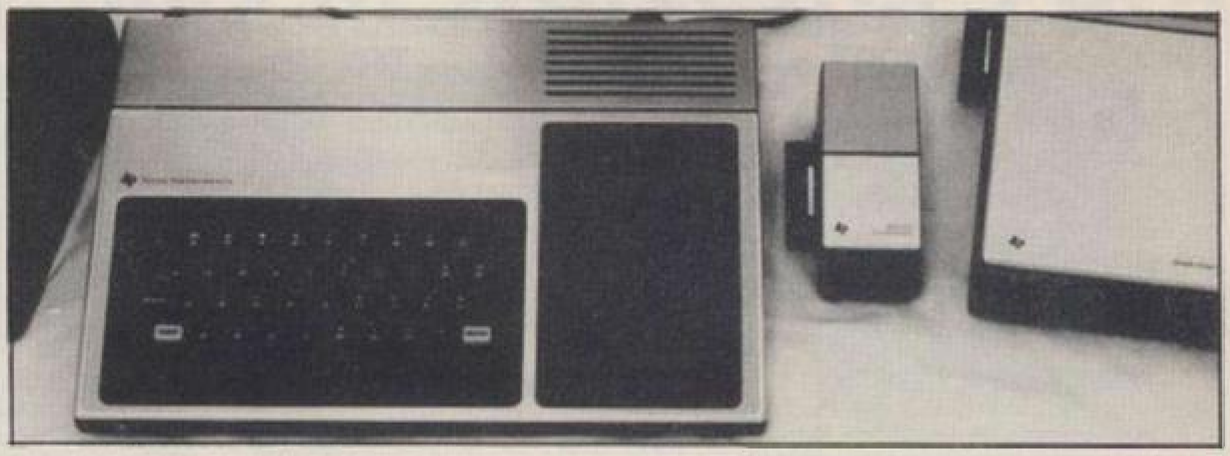
PETSPEED IS THE FIRST optimising compiler to be released for any microcomputer. Several compilers are now available for the BBC Micro, the Spectrum and even the ZX-81. These just concentrate on converting a Basic program into executable machine code and can only cope with about 80 percent of the available Basic commands. An optimising compiler goes a step further in trying to compile code efficiently and compactly.

Petspeed runs on the Commodore-64 and the Pet, and makes programs run up to 40 times faster. Typical compilation times average two minutes, one second per line of Basic code, and most programs can be completed in about five minutes.

This is a far more substantial package than the other compilers for home computers, although at £125 it costs correspondingly more. It comes with a security device — a dongle — which plugs into the back of the computer and protects Petspeed from unauthorised tampering. In addition the compiler makes a few improvements to Pet Basic: it allows long variable names to be used and extends the Def FN command to handle strings.

Petspeed is available direct from Oxford Computer Systems, Woodstock, Oxford or from Commodore dealers.

Texas extends range with £90 16-bit black and white micro



TEXAS INSTRUMENTS will launch the TI-99/2 in Britain later this year. Texas unveiled the new machine at the Las Vegas show in January. Specification includes 5K RAM, 16-bit processor — the new TI 99/95 chip designed in the UK — and a moving-key keyboard, all for £90. The machine will have plug-in ROM packs with additional programming languages like Pascal and Logo.

Texas is backing "computer-literacy" machines which primarily teach you about computing rather than the family micro. It is the cheaper end of the market that Texas find interesting.

A family of hand-held Basic computers is also scheduled for release this year. However, the TI-99/4 is not to be phased out. The machine has been very much the poor relation in the home computer market, suffering from the effects of its initial test-marketing at a price of £650. Since November when a £50 money-back voucher effectively brought the price down to £150 sales have quintupled and Texas is now out of stock both in Britain and America.

There are now six production lines operating solely on TI-99/4 production in the States — executives have been turfed out of their suites in Lubbock to create floorspace — plus the Italian facility at Rietta which assembles the machines for the European market.

A further plank in the market platform will be the addition of programming languages like Fortran and Pilot for the TI-99/4. With the new Peripheral Expansion System the computer's memory can be enlarged, diskettes can be run and printers connected. The motherboard, has eight slots for peripheral board-type cards, one of which is used to link the system to the computer console. Additional peripheral cards are plugged in to add the desired functions. There is room to install one TI disc drive in the box, and two additional disc drives can be added externally.

Texas is more interested in semiconductor design than in electromechanical devices like disc drives. Research is primarily into chips. The TI-99/9 which will appear in the TI-99/2 computer has control logic built into the chip and 256 bytes of onboard RAM — not a microprocessor but a microcontroller, says the company. It has strong possibilities for robotic/real-time applications.

Sands of Timex may run out soon for British Sinclair production

SINCLAIR IS PREPARED to stop producing computers in Britain if the Timex dispute cannot be resolved. At Timex in Dundee, where the Spectrum and ZX-81 computers are made, the management is threatening to sack 1,900 of the workforce. If the threat is carried out and the workers go on strike Sinclair Research "will move our business elsewhere, probably permanently."

Sinclair Research claims that this will not hit production of the ZX-81 and Spectrum. "We have large stocks, we could do it overnight — there would be no effect on customers." British production of the ZX-83 which Sinclair Research boffin Nigel Searle describes as "a radically different computer" could be endangered — although the machine is not due to go on sale till the Autumn.

600 work on the computer lines at Dundee and these too would lose their jobs if Sinclair follows the example of Timex's other high technology product — the Nimslo 3D camera — which stopped production at Dundee just before Christmas to move to Japan.

Sinclair's computers already include chips made everywhere from El Salvador to Portugal and the company is now prepared to move production of the finished computers overseas if it is not happy with the alternatives in Britain.

THE GUARDIAN

Next month a cut-price entry to the phone-line version will be offered by the Prestel service of British Telecom. This will have a library of 1,000 programs at the start, covering the usual range of education, video games, household management and the like, all fed directly into the home computer.

The BBC service will be gin with around 500 programs, many of them for schools and supplied by the Government's Microelectronics Education Programme.

Drunk with success?

Currah Computer Components have produced a speech synthesiser for the Vic-20. They have given it the same name, Chatterbox, as a similar device for the Spectrum, described in last month's news pages. Like its namesake it allows the user to construct an infinite vocabulary of spoken words out of a number of sound units. As an extra the Vic Chatterbox incorporates a series of software routines in EPROM to facilitate programming of the device. These include an interrupt driven routine which voices the keys as they are pressed, and software for inputting speech phonetically. The speech synthesiser will be distributed through the Spectrum dealer chain or is available directly from Currah Computer Components, Greythorpe Industrial Estate, Hartlepool. Recommended retail price is expected to be around £60.



Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

Computerniks in Worcester Park





Networking is but one of the ALCC's interests. Simon Beesley checks out his Worcester sources.

THE ASSOCIATION of London Computer Clubs — ALCC — binds together most of the clubs in the London area in a very effective organisation. Its functions are many and varied. It has established electronic communication between clubs, organises the annual London Computer Fair, co-ordinates club activities and generally tries to promote hobby and recreational computing.

Looking at the map of London early last year the officers of the ALCC saw that there was a large tract of South London running from Croydon to Woolwich which was not furnished with a computer club. Let there be a club in Worcester Park, they cried, and to this end they organised a computer fair at the Worcester Park Library. By the end of the fair more than 100 members had signed up for the new club which now meets regularly once a month at the Worcester Park Library.

The evening *Your Computer* visited the club, Prestel adaptors for the BBC Micro and the Sirius were on display for the first time. Adapting these micros to link up with Prestel is largely a software problem. Harry Broomhall, who has written the software package for the Sirius, demonstrated it using a Tantel adaptor. Bob Forster from the Richmond CC used an acoustic Modem with the BBC package.

This was an interesting introduction to the variety of services the Prestel network offers. Aladdin's Cave on Prestel contains a number of pages of software which can be downloaded into some of the popular home micros. After a few false starts Bob Forster managed to download and run on the BBC a useful little program which explained the basics of digital electronics — an impressive demonstration.

The ALCC itself provides about 300 pages of information on Prestel. These include a newsletter, a magazine section, snippets of information on particular micros and pages devoted to the activities of each member club.

We looked up the Worcester Park pages and there we were — a Prestel demonstration booked for that very evening. Meanwhile, on the Sirius, Len Stuart, the secretary of the ALCC, showed how to edit a page while he updated some of the information on the ALCC's forthcoming Sutton Computer Fair.

Also available to ALCC members is the mailbox facility which enables them to leave and pick up messages for each other. Harry Broomhall logged on and received a pre-formatted frame from David Annals of the Croydon CC. Next to a picture of a reef knot read the message "Get knotted".

Finally, Harry Broomhall gave us a glimpse of Dynamic Prestel, British Telecom's latest development. By accessing BT Research's demonstration pages we were able to have a look at some moving graphics illustrating the Adventures of Prestel Man.

Normally the Worcester Park club's meetings have a fairly informal format. Many members bring their own computers along, which are predominantly Spectrums and BBC Microcomputers. The BBC Micro seems to be the computer enthusiast's choice and is usually well represented at computer clubs.

Meetings are held on the first Monday of every month. For more information contact Norman Beattie on 01-337 3747. ■

Local society news

Bognor Regis Bugs

BOGNOR REGIS now boasts two computer clubs, RAMS and BUGS. RAMS, the Regis Amateur Microcomputer Society, meets on the second Tuesday of each month at the Regis Centre and tends to be a little more formal in its approach. BUGS, the Bognor Users Group, meets on the last Thursday at the RAF Association Club, Waterloo Square. Contact R H Wallis on Pagham 66795 for details on RAMS, and the Bognor Microcentre on Bognor 828108 about BUGS.

South Northamptonshire

SOUTH NORTHANTS Microcomputer Users, Group have changed their meeting place to the Anchor House, Moat Lane, Towcester. They meet weekly on Wednesday evenings. Ring Simon Clark on 0327-52191 for further information.

Starting in Sutton

SUTTON COMPUTER CLUB has just held its inaugural meeting. In the future, meetings will be held monthly in the main library, Sutton, Surrey. For further details contact Jennifer Weller on 01-661 5046.

Cannock computing

CANNOCK COMPUTER CLUB meets fortnightly at the premises of Cannock Computer Systems, Old Penkridge Road, Cannock. Members own a wide range of microcomputers from the ZX-81 to the Sirius. Subscription is £3 for adults, £1 for students and there is a small charge at each meeting to cover refreshments.



Now that disc drives are available for most popular home computers David Simpson and Simon Beesley examine the whole area of mass storage and in particular drives for the BBC Micro, ZX-81 and Vic-20.

THE DISC REVOL

ONLY FIVE YEARS ago various computer industry pundits were predicting the demise of the disc drive — to be replaced by magnetic bubbles, and other more exotic storage devices.

But that was in the dawn years of personal computing, and the disc drive, even though it was expensive, mechanical, and unreliable, compared to its predicted solid-state replacements, has increased in numbers and performance while achieving previously undreamt-of price reductions.

Floppy-disc drives are now available for most of the wide range of personal computers — from 800K dual drives for the BBC, down to a 42K drive for the ZX-81. The advantages disc storage offer over cassette are considerable. Firstly, loading and saving to disc takes a matter of seconds rather than minutes; secondly the computer does not need to read through programs on a disc in sequence but can access any program at any part with equal ease.

Just as valuable a feature is the housekeeping role of the disc-operating system. By taking over the business of locating programs and finding space to store new ones, the system removes a large part of the tedium associated with cassette storage.

For the benefit of newcomers to disc drives, let us look at how a disc system works and explain some of the terms involved.

The disc itself is coated with a similar magnetic material to that used on tape. Unlike a record disc which has a spiral groove, a floopy disc stores its data in concentric tracks. It revolves inside a square protective jacket at a rate of 300 revolutions per minute. A slot in the jacket allows the drive head to pass in and out along the disc radius stepping from track to track.

This ability of the drive to move the read-write head to any track in a very short time is what gives disc systems their random-access capability. When the correct track has been stepped to, there is only a short waiting time before the required stretch of data passes across the head.

Around each track, data is stored in a blocked or sectored format and a new disc needs to be formatted before it can be used. Formatting a disc marks out every track with an equal number of sectors.

The number of tracks and the way each is split into sectors varies from system to system. On the Vic system each disc is given a format of 35 tracks with 17 to 21 sectors, while the BBC disc-filing system allocates 10 sectors to each of 40 or 80 tracks. Sectors in both these formats are 256 bytes long. Most drives can only handle a fixed number of tracks and type of drive used determines whether a disc is given 35, 40 or 80 tracks.

SURVEY



UTION

To make the hardware actually do something appropriate, software must exist in the computer. This is known as the Disc Operating System or DOS. It is usual for the DOS to be stored on one or two tracks of the floppy disc. When the computer powers on, a small program in ROM "boots up" these tracks from the disc into RAM and then jumps to execute the DOS.

Some of the latest disc systems adopt another approach which is to store the entire DOS in ROM in the computer. This allows all the RAM to be used for application programs. The three disc systems reviewed in this issue use this method.

One of the tasks of the disc-operating system is to keep track of where programs are stored. It reserves a few sectors for a directory or catalogue.

When the DOS writes a file to disc it records

(continued on next page)

ZX–81

MACRONICS SUPPLY a disc-drive system for the ZX-81 for £293 — almost six times the cost of the computer itself. Some ZX-81 owners are remarkably dedicated to the machine and the idea of forking out this amount may not seem absurb: if you have already invested in a keyboard overlay, a 64K RAM pack or perhaps a high-resolution board, fitting a disc interface must be the ultimate step in customising your ZX-81.

A surprising number of people use the ZX-81 for small business purposes and the micro may yet find its final resting place in control applications.

The dreaded membrane keyboard has an advantage here in being coffee-proof. For these uses, a disc system may also be worthwhile.

Some people clearly think so. Macronics are selling all the units they can produce, many of them to overseas buyers.

But whether it is good value or not, the FIZ interface card and disc drive certainly enhance the ZX-81. Tape loading and saving is one of the most irritating features of the ZX-81 — along with the keyboard. It is both slow and unreliable. FIZ loads an 8K program in 10 seconds and saves 8K in 20 seconds. As disc drives go, this is not fast but it is an immense improvement on cassette times. The drive also makes program storage trouble-free. We successfully saved and loaded every program first time.

The system comprises a 35 or 40-track drive, an interface card and an expansion bus, which plugs into the back of the ZX-81. The interface card plugs into the expansion bus and contains the Disc Operating System in 4K ROM, as well as 2K RAM. There is an edge connector on the expansion bus for the RAMpack or printer, and a spare slot for an additional add-on card.

Macronics use a bulky 5.25 inch Shugart drive with its own power supply, although the interface will work with other equivalent 35 or 40 track drives.

Nine disc commands are provided by the DOS. These are called through USR commands. To produce a disc-directory listing, displaying the file names of all the programs on a disc, you need to enter,

```
LET E = USR DIR
```

DIR is one of the reserved variables which contain the addresses of the command routines.

```
LET E = USR 9999
```

calls the initialising routine which assigns these addresses. Without initialising you must provide the numeric address itself.

```
LET E= USR 10008
```

for example, is an alternative way of producing a directory listing.

The command, Stat, can be used to find the length of a file on disc or the number of free sectors left. Newd formats a new disc and gives it an identifying name.

Before calling loading and saving routines it is necessary to assign the program name to FS, as in:

```
LET FS = "NAME"
LET E = USR DSAVE (or USR 10002)
```

The same procedure is required when you erase a file with the Kill command.

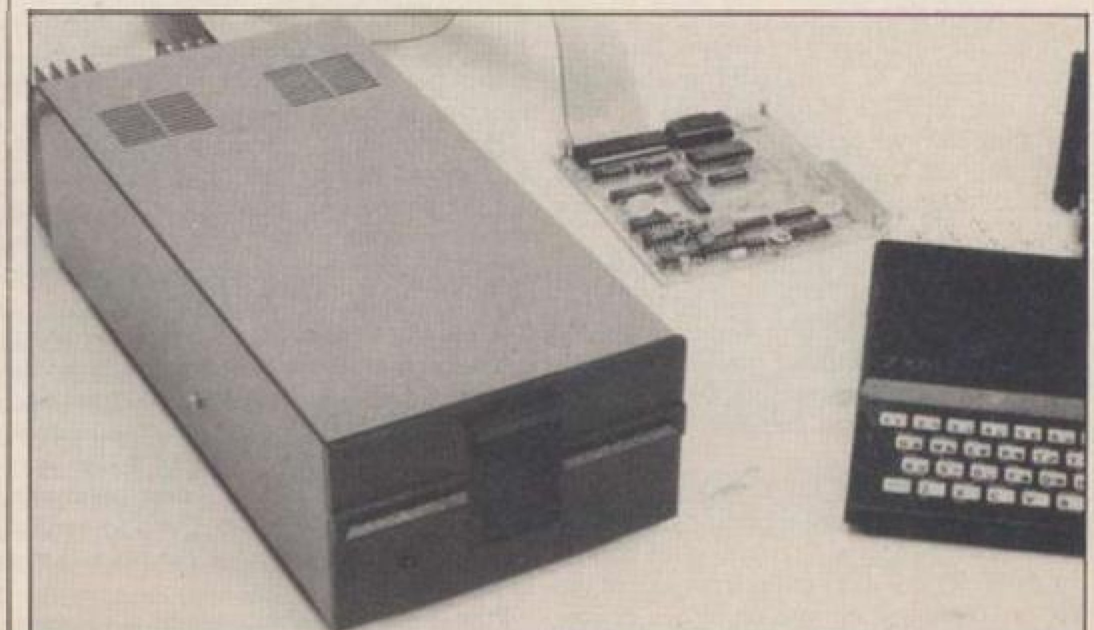
There is also a rather simple facility for writing and reading random-access records. Create sets up a data file with a pre-specified number of records. When the number of the record has been assigned to R and its contents to RS, Read or Write can be called.

The limitation to this option is that each record occupies a fixed length of one sector, 128 bytes, and that the number of records in a file must be given in advance.

Compared to other disc systems, the commands FIZ offers are strictly functional with no frills and refinements. Storage capacity is also relatively small. The maximum storage for 35 tracks is 42.5K and 48.75 for 40 tracks.

Nevertheless, interfacing a disc drive to the ZX-81 is something of an achievement. In the light of the micro's limitations this is quite an effective disc system. Presumably most buyers will be content that Macronics have released them from the rigours of cassette storage.

Macronics has also adapted their interface for use with the Hungarian micro-cassette drive, the MCD-1. But it will not go into production of this version until the Hungarian manufacturers manage to supply the unit in quantity. The price for the drive and interface together is expected to be around £200.



(continued from previous page)
its location in the directory. In turn, when it reads a file, it consults the directory to find at which sector on which track the file starts. In disc usage, incidentally, the term, file, covers both programs and data.

Like cassettes, floppy discs vary in quality and price. A single disc can cost from £1.50 to £2.50.

Although they usually bear such labels as 40-track, 80-track, single-density or double-density, discs arrive from the manufacturers in a blank unformatted state.

These terms indicate how the manufacturers expect them to be used and consequently the standard to which they are made and tested.

Double density refers to the number of bits of data that can be stored per inch. A double-density disc could be formatted to carry twice as much data per sector — 512 bytes for example instead of 256.

However, it is certainly possible to use double-density discs in single-density format — just rather wasteful. Similarly, at a pinch, you can write 80 tracks to some high-quality brands of 40-track discs, such as Wabash.

Double density should not be confused with double-track density which simply means 80 as opposed to 40 tracks.

One further distinction to be made is between single and double-sided discs. Some drives have two opposing read-write heads which permit them to read both sides of a disc. But, again, although all discs are coated with magnetic material on both sides, the manufacturers do not test both sides unless the disc is to be used with a double-sided drive.

As the computers are increasing in processing power, and shrinking in physical size, disc drives are following a similar course.

The floppy disc was, in its first generation,

(continued on page 38)

THE BBC MICROCOMPUTER Disc Filing system consists of several parts. There is the Model B computer; the disc interface, which is several integrated circuits installed onto the main circuit board; the disc-filing system software, which is contained in a single 8K-byte EPROM in one of the spare ROM sockets in the computer; one or more 5.25in. minifloppy disc drive and associated cables for data and power.

The majority of the disc-interface hardware functions are performed by a single Intel 8271 disc controller IC. This seems to be a strange choice by Acorn as it is now an obsolete device and thus costs in the region of £35. There are several more modern disc controllers which, because of volume production, are much cheaper and offer improved performance. Unfortunately they are not compatible with the 8271. Aside from this chip there are several TTL and CMOS chips to handle the interface to the disc drives themselves.

Having had my model B upgraded by the addition of the necessary chips at a cost of £72 plus VAT, I was dismayed to learn that, unless I also puchased an Acorn disc drive, I was not going to be able to get a disc manual or a utilities disc. I already had a pair of brand new TEAC-80 track drives which I wanted to use so there was no way I was going to buy the Acorn discs. The reason given by Acorn in their glossy brochure on the Disc system is that "the DFS manual is not supplied with the disc interface components as when used with other makes of disc drive correct operation cannot be guaranteed."

However, when I at last got to read the DFS user Guide I found, on page 81, the statement "several different disc drives may be used with the BBC computer. . ." It then describes how to set up the link options in the computer for different brands of disc drive. Surely some clarification of this contradiction is needed from Acorn as there is a considerable saving to be made by not using the Acorn drives. For example the Acorn single drive which has a capacity of 100K Bytes is £264 but a CDC drive from Microware having the same capacity is £172.

For this review I tested not only the Acorn single drive but also drives manufactured by CDC and TEAC and all performed satisfactorily. Also available from Acorn is a dual 80-track, double-sided disc unit. This is priced at £799. By shopping around it is possible to obtain many different combinations of disc capacity and price at a considerable saving over the Acorn units.

The Disc system User Guide is very well written and provides a good introduction to disc systems as well as detailed descriptions of all the DFS commands and facilities. All DFS commands are preceded by *, in common to the Machine Operating System — MOS — commands familiar to BBC owners.

Thus *Cat lists the current disc's catalog on the screen,

*DELETE "filename"

removes a file from the disc and so on.

The clever thing about the DFS is that all of the commands available in the cassette filing system of the standard computer are available, using an identical syntax, in the disc system. This means that most programs will be able to run with no modifications when translated on disc. Of course there are many more commands and functions available for use with discs. To help in using the correct syntax, the command *HELP can be typed. This then displays a list of all DFS or utilities commands, with the necessary syntax.

If an error is made when typing a command,

WHEN COMMODORE released its single-disc drive for the Vic-20, early last year, it carried a price tag of £396. This probably restricted its market to those people who were developing software for the Vic commercially, or the few owners who used the Vic for business applications.

The Vic-1540 now sells for a less daunting £300. A further attraction is that it can be adapted for the Commodore 64 by changing a single ROM chip.

It has the advantage over cheaper drives for other machines of being self-contained. No extra disc interface is required and no disc-operating software needs to be loaded into the computer: the Disc-Operating System and its related disc-maintenance commands are already built in.

The drive contains its own 6502 processor, ROM and 2K RAM. These and several other chips make it an intelligent device capable of running programs without troubling the Vic. Formatting a disc, for example, takes about 80 seconds but leaves the computer free for its own pursuits.

Since the 1540 uses the same serial port as the Vic printer you must reconnect the printer to one of the two serial interfaces at the back of the drive. By this daisy-chain arrangement the Vic can communicate with up to five devices through the one port.

Transferring data in serial rather than parallel form means that the 1540 is a little slow in disc-drive terms. It takes around 18 seconds to save a 6K program and 12 seconds to load it. This is a few seconds more than on the BBC disc system but quite fast enough for the average user.

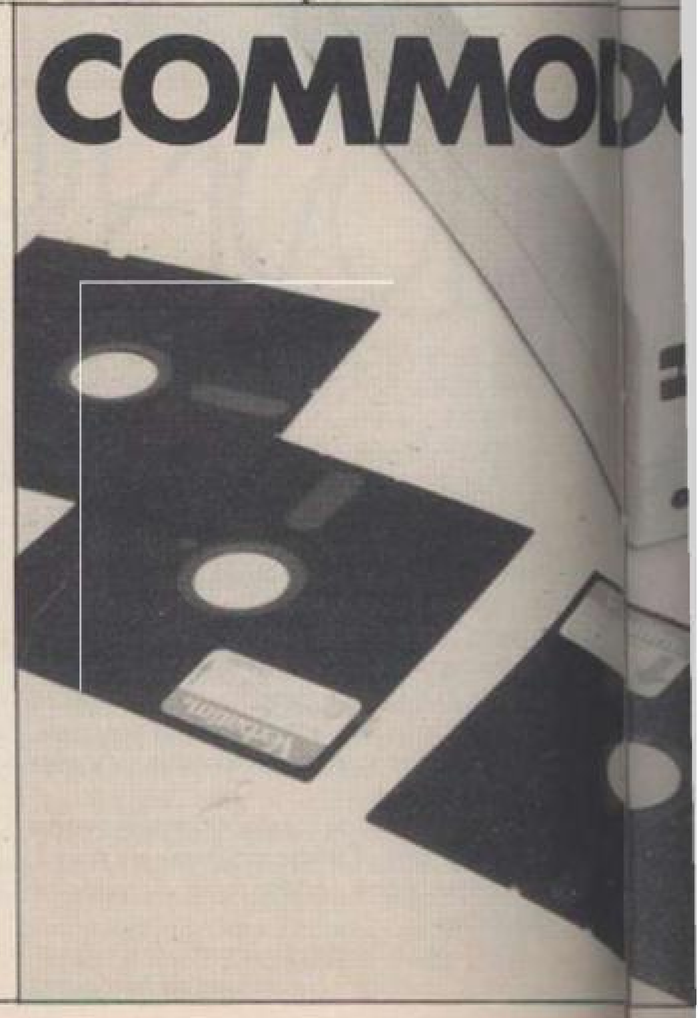
On the plus side the Vic drive takes the same floppy discs as the BBC drives — single-sided, single-density — but formats them to give almost 170K capacity on 35 tracks. While the BBC disc system allows a maximum of 32 entries per disc, the 1540 can store up to 144 program or sequential-data files on a disc.

How easy is it to operate the Vic drive? Saving and loading are straightforward and use the same Basic commands as the cassette system — although you need to tag the disc drive's device number, eight, on the end — as in SAVE "PROGNAME", 8.

You can also Verify a program you have saved.

The other available Basic commands are for storing and loading data files to and from disc. Print # reads data into the computer. Get # has the same function as Input # but only transfers a byte at a time. These commands must be preceded by an Open command which opens an input or output channel to a specific device.

Print # is also used to send one of the seven commands which are supplied by the disc-



this correct syntax is displayed; much more useful then something like error 25.

Some problems will be encountered when trying to run certain existing programs on the new system. This is due to the fact that user RAM under the 1.2 MOS now starts at 6400 rather than 3584. The extra 2.8K bytes is used for DFS work space. Programs such as Acornsoft's Snapper, Monsters etc are machine code programs which were assembled to load and run from location 3584, so will not work if loaded somewhere else in memory by the disc system. The solution in this case is to *LOAD the program at say 3000 and then move it down to 3584, using a short machine code routine, before running it.

Using this approach I am now able to load and run Snapper in under four seconds. Typically an 8K program takes under two seconds to load. Apart from its ability to rapidly save and load programs, what else significant is there about the disc system?

Well, all the commands listed in the Disc User guide seem to function as listed, but I have come to notice a few deficiencies in some of the commands. For example there is a limit of 31 files per disc catalogue. Now 31 may seem like a lot but with 80-track discs, which have a capacity of 200K bytes much of the disc capacity is wasted if programs are short.

The annoying thing is that the *CAT function does not give any indication of either the number of catalog entries made so far or the remaining disc storage capacity. You have to count the filenames as they are listed on the screen or else wait till the error message "Catalog full" appears!

To find out the remaining disc capacity it is necessary to use the *COMPACT function, which moves all files on the disc towards the outer tracks, leaving all the remaining space at

BBC



the end.

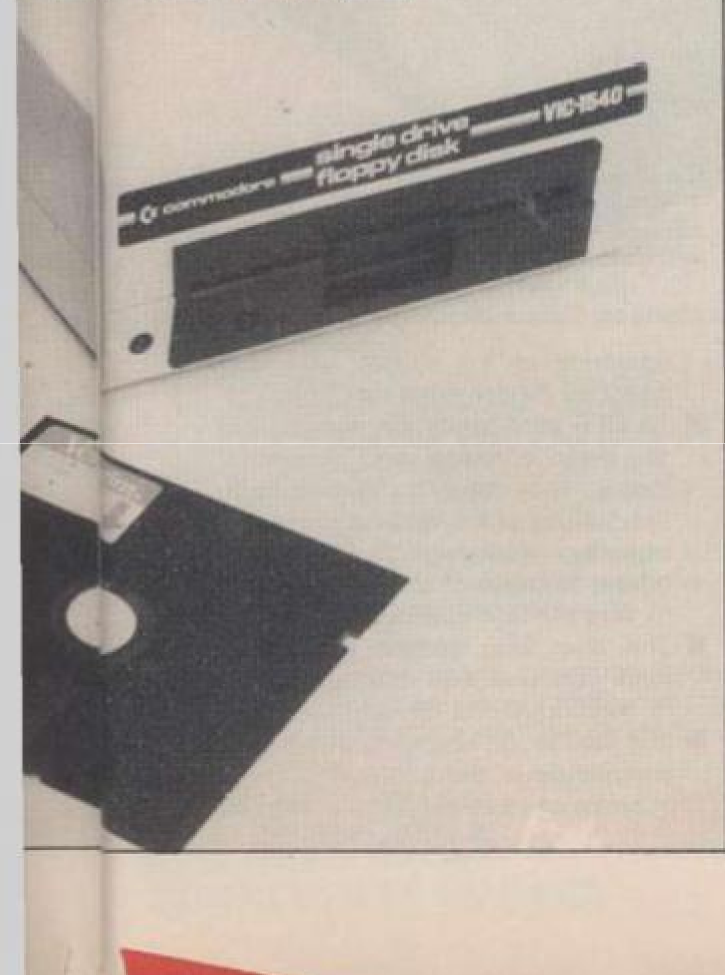
The only other feature of the system which could be improved is the *COPY function. If only a single-drive system is being used it is necessary to swap source and destination discs when copying files from one to another. Now there is a "wildcard" filename system, where # matches any single character in a filename and * matches any number of characters allowing sya # . A* to match $, AFILE, Z.A1, B.ANAME. This means that it is possible to copy multiple files with one command.

Unfortunately, if only a single drive is available the system will copy only one of the multiple files requested before prompting for the user to swap discs. It does not attempt fill up all available RAM with data before requesting a swap.

Of course if two drives are used there is no problem, just a lot of "clacking" back and forth between drives. It is little things like this that can make a big difference to how user-friendly a system is.

Apart from these small gripes the system works very well and certainly adds much to the pleasure of using the BBC Micro. ■

DORE



operating system. Thus to delete a program from a disc with the command Scratch you would need to enter;

```
OPEN 3,8,15
PRINT # 3,"SCRATCH0: TEST1"
```

This opens a command channel to device 8, the disc drive, and then deletes the program Test1 from drive 0.

Among the other commands which are specific to disc systems are Copy which copies a program or data file to another disc or on the same disc, and Rename which changes a file name. Copying to another disc requires another drive; there is no option for making back-up copies of a disc by swapping two discs in the same drive while the operating system switches the data in and out of the computer's RAM.

NEW is the command for formatting a new disc, not to be confused with Initialise. The manual insists that every time you insert a disc you should use the Initialise command to enable the drive to identify it correctly. In practise it does not seem to be necessary.

The last two disc commands are Validate which ensures that disc space is efficiently allocated, and LOAD "S" which reads the disc directory into the computer. Listing the directory shows the names, type and size of all the files on the disc and the amount of space left.

Unusually, for Commodore, the syntax of some of these commands is not well-explained in the manual. Anyone who has used the Open command with the printer or in setting up data files on cassette will not have much trouble; but others might find the procedure for setting up, say, a sequential file a little complicated at first.

The spread of commands described should cater for most needs. Sould you want more, you will have to delve into the chapter in the manual that explains advanced disc programming. This gives detailed information on DOS structure and on a further set of disc utility commands which may be used to create random access files or devise special disc-handled routines. Finally since the Vic-1540 has been around for a while we can ask how reliable it is. Disc drives need to be very finely-engineered devices. The read-write head has to be moved over the disc rapidly and with considerable accuracy. This offers far more scope for mechanical error than on a cassette recorder.

A small survey we conducted indicated that the drive performs pretty well. One software house we spoke to has used three drives intensively over the last nine months. None of them developed any hiccups and the only problems met with came from using low-quality discs. ■

(continued from previous page)

8in. diameter and stored 250K Bytes. Then came the first 5.25in. minifloppy from Shugart. It was able to store 80K Bytes on a disc only 40 percent of the area of its big brother. In the years since the birth of the 8in. floppy the data storage capacity drive power requirements, access times have improved many times. But as the computer shrinks to pocket sized dimension, even the 5.25in. drive is too big. So next in line will be a micro floppy using a disc approximately 3in. to 4in. diameter, which will eventually store 1-2 M bytes.

Rapid introduction of the micro-floppy is being delayed by a battle raging between rival manufacturers. There are about four different drive designs which are all incompatible. Each is vying for industry acceptance and for disc-media producers' support.

Some of these microfloppies are already available to OEMs — original equipment manufacturers — for inclusion into their new products. Best known of these are the Sony 3.5in. and the Hitachi 3in. From an unusual source, Hungary, comes the MCD-1 which uses a 2.75in. disc in a hard jacket.

This competes with the other drives, all of US or Japanese origin. It will be interesting to see if a new "industry standard" comes out of the current negotiations, as happened with the 8in. and 5.25in. versions. It may well be, as with videotape, that several incompatible drives could each capture a section of the worldwide market.

Another type of disc technology that will increasingly become available for use in personal computing is the so-called Winchester disc. This features order of magnitude improvements over floppies in storage capacity and data transfer speed, for example a typical 5in. Winchester drive stores 25M bytes and transfers data at 625K bytes per second compared with 1 M Byte and 250K bytes per second for a minifloppy. Until now there have been the problems of high cost and non-removeable media with this type of drive.

The latter problem has required the regular backing-up of data on the disc to a removable medium, either many floppies or expensive digital cassette. But the next generation of Winchester discs will be smaller, cheaper and have removable discs. There is talk at present of a 3.5in. Winchester drive which will have the same outline size as the Sony 3.5in. micro floppy but storing in the order of 3-5 M bytes.

If these drives fail to satisfy your requirements for data storage there is always the newest technology of all, that is, the optical disc.

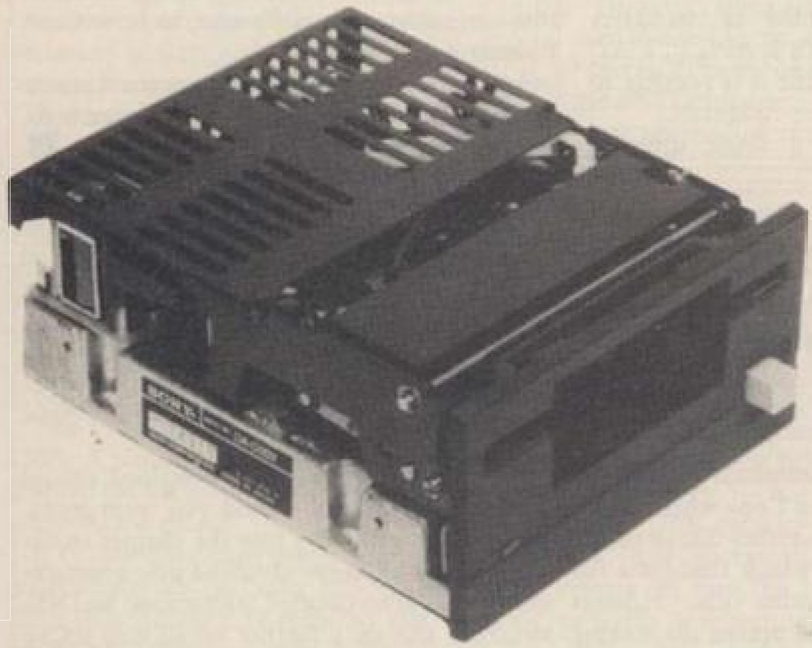
At present this comes in two versions, read only and read-write. Read-only, is typified by the Philips Laservision Video disc and the Sony CD or Compact Disc for audio use. The Laservision could be used for storing mixed video and data thus making interactive games using real pictures possible. Data capacity is a massive 18,000 M-bytes. The CD is interesting because it offers, in the size of a standard 5.25in. minifloppy drive, the capacity of around 1000 M bytes and has a data transfer speed of 500K bytes/sec.

Read/Write is of more interest to the computer user as a disc that can have data written onto it. At present even prototypes of this type of disc are "write-once" and cannot be erased. But if the new Sony 8in. optical disc prototype is anything to go by the disc has such a large capacity — 2000 M bytes — that having old unerased copies of files on the disk will not be too much of an inconvenience and in effect provides a built-in backup facility.

These types of drives are not likely to appear commercially for a few years yet so conventional magnetic discs are not likely to disappear overnight. ■

MICRODRIVE

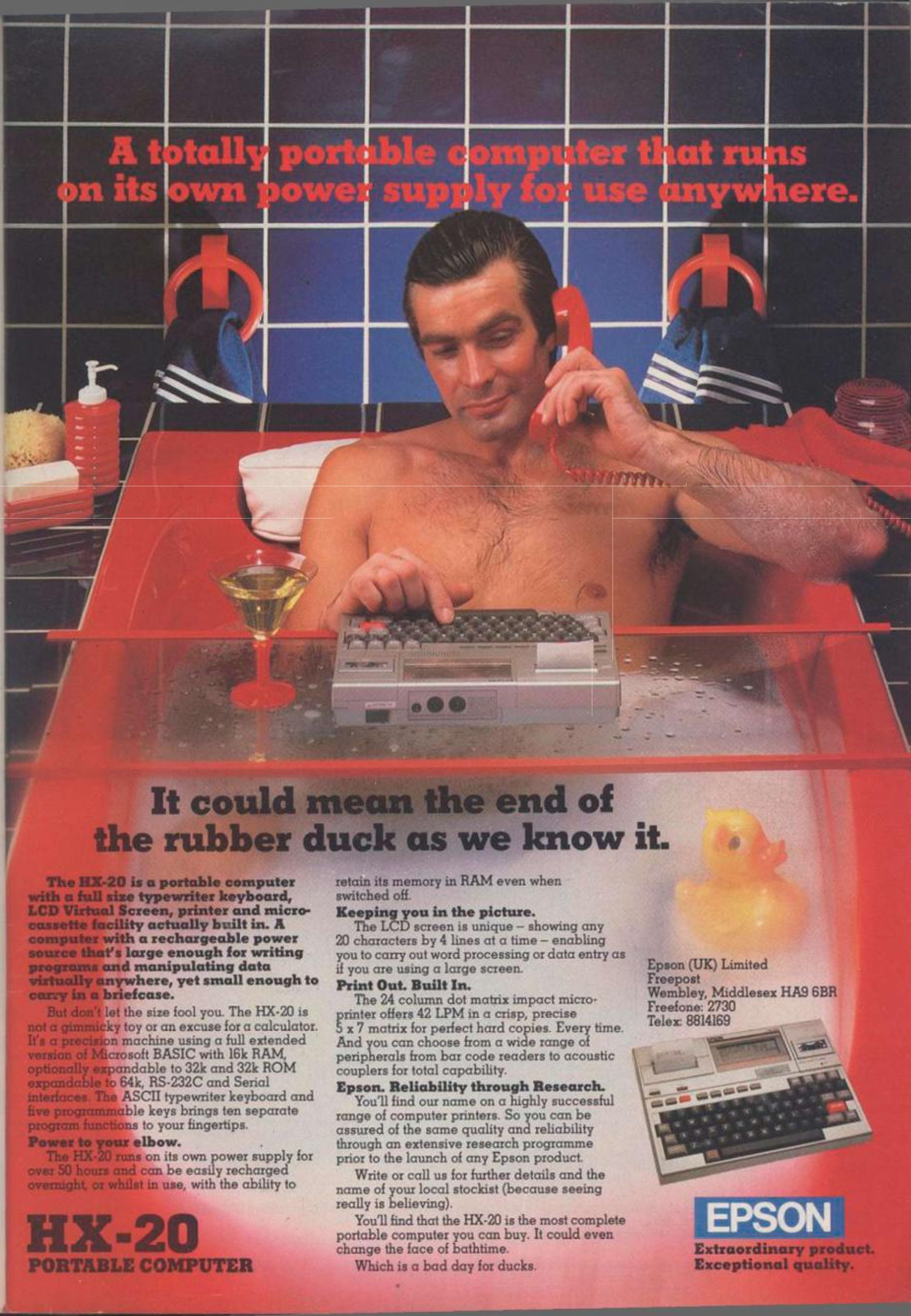
Sinclair's Microdrive is not a true disc drive but a stringy floppy endless tape loop. Although the 100K capacity, and the data transfer rate of 16 Kbytes per second are impressive, the 3.5s. average access time will make the drive too slow for many uses. Nevertheless at a price of £50 for the drive plus £30 for the interface the Microdrive is bound to be a success when it is released in March.

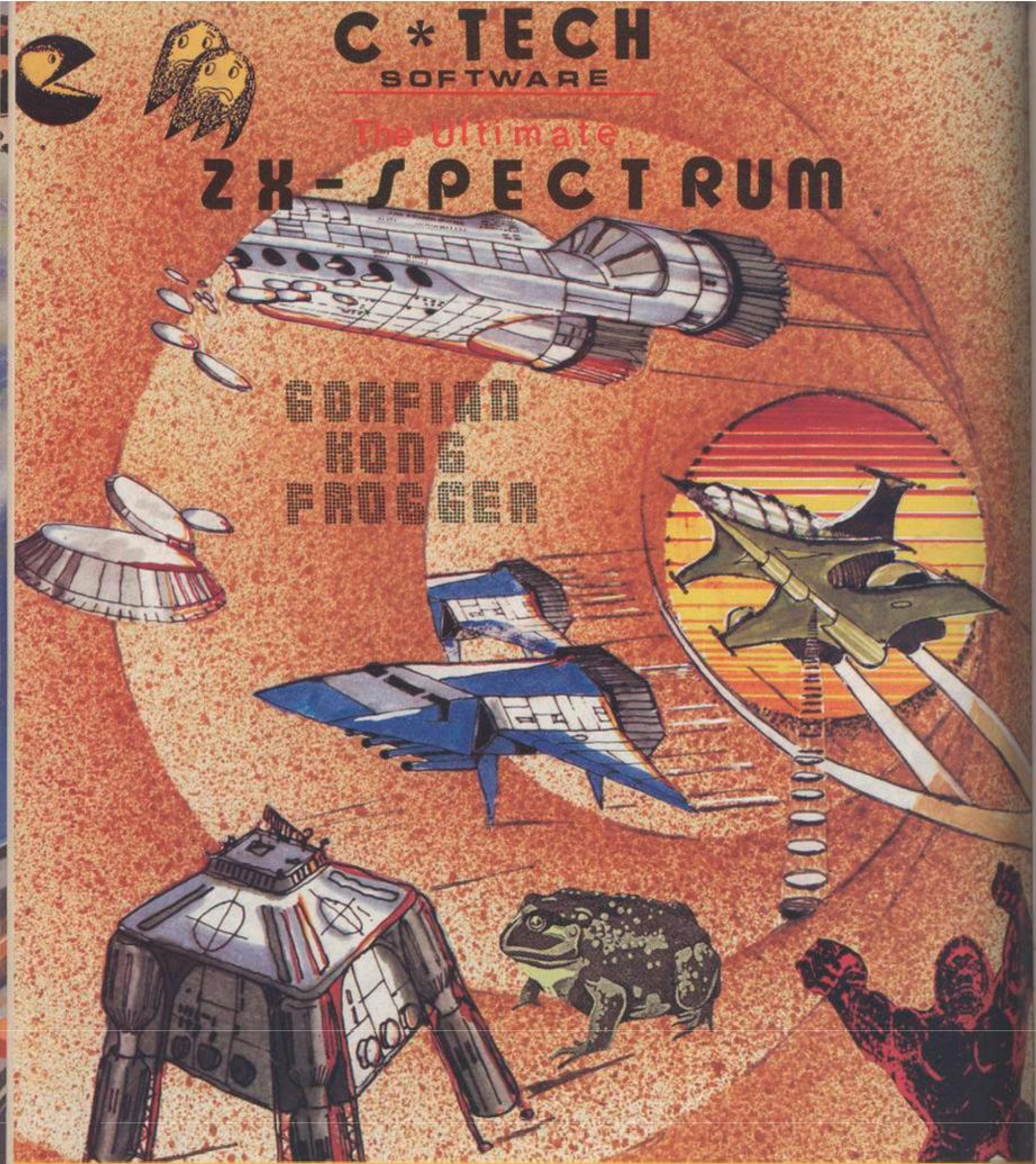




Conclusions

- As disc systems go the Floppy Interface for the ZX-81 is relatively crude.
- The range of commands offered is limited and disc capacity is a meagre 42.5K. But in view of the fact that the ZX-81 was not designed to take a disc drive the FIZ is an impressive achievement.
- It greatly facilitates storage on the ZX-81 and can be recommended to anyone who is committed to using the ZX-81 for serious applications.
- The Vic-1540 comes conveniently equipped with a disc-operating system and just needs to be plugged into the back of the Vic.
- Although the system is comparatively slow and not as easy to use as, say, the BBC disc system it provides a useful set of commands and functions.
- Disc capacity is substantial — for a 35-track single density disc — at 170K with up to 144 directory entries.
- The drive appears to be well made and reliable.
- The BBC Disc system enhances the operation of the already very well designed fundamental machine.
- All DFS commands are easy to use and have a logical and consistant syntax. There could be a limitation to the full use of available disc storage capacity, especially for 80 track drives, because of the restriction to 31 files per disc catalog.
- The disc filing system appears to work very well with different brands of minifloppy disc drives.
- It is well worth shopping around for alternatives to the Acorn disc drives in terms of value for money. ■


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LYNX



Fun at home — effective in the office. Will the Lynx's wonder ingredient CP/M make Camputers' claims for its elegantly-styled 48K colour computer wash whiter? Bill Bennett put it to the test.

THERE ARE two ways of making money from engineering — and the same rules apply whether you are a car manufacturer or a computer designer. The first way is to produce some astounding new idea or gimmick, and pray that the idea catches on. This is a risky business, but it can pay huge dividends: for example, there was the ZX-81 and the model T Ford.

The other way is less fraught with danger, but then the designer stands to gain less too. It involves looking at existing engineering ideas and combining a number of them in a new way. This is what has happened with the Lynx.

The Lynx is simply a good micro. It has no wonderful outstanding qualities, but in every department of its specification it ranks alongside the best. It is as though the designers took the best features of all the popular micros and put them together in the one box.

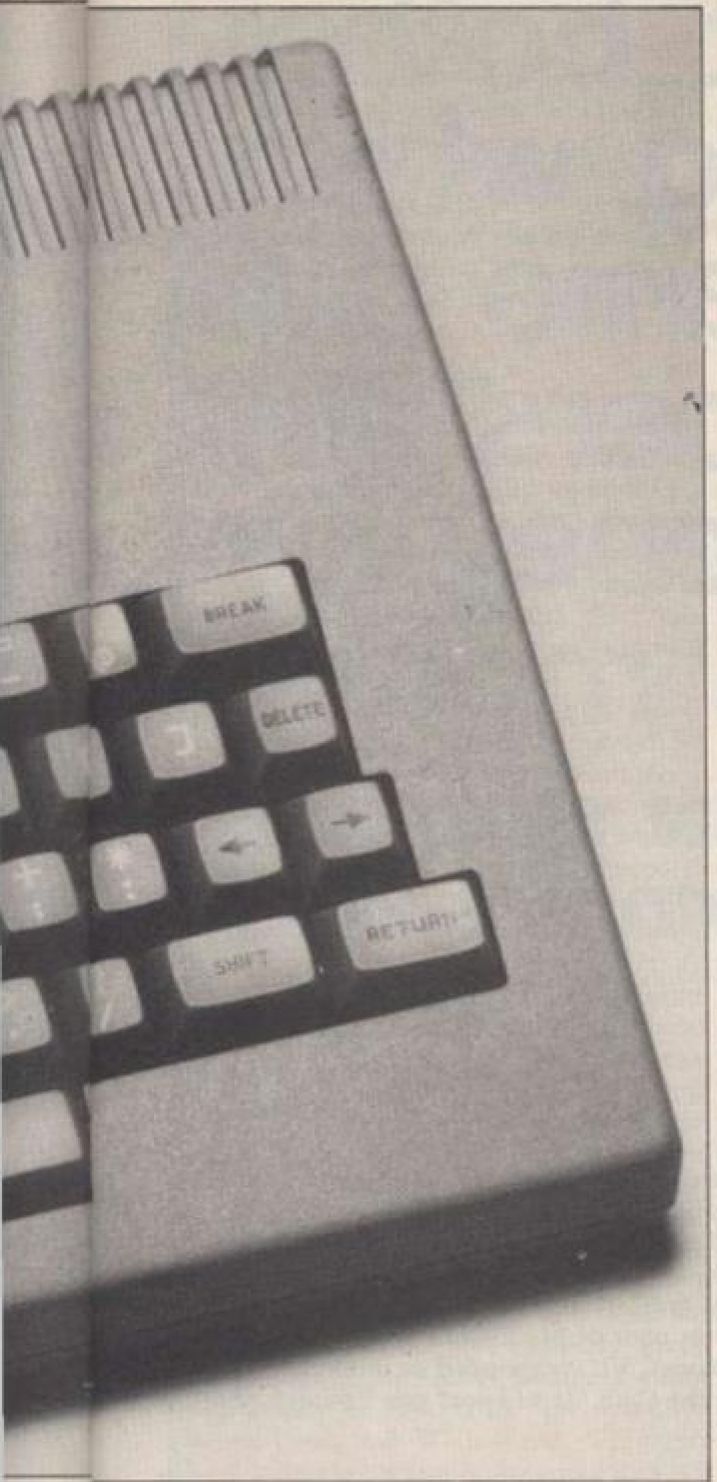
So the Lynx represents a consolidation of previous advances as well as a tiny advance of its own. By utilising technology that has already passed the test of time, it should have fewer teething troubles than some micros which aim to break new ground.

The standard Lynx has 48K of user RAM, which leaves 16K for programs and data when in the high-resolution graphics mode. This can be expanded inside the case in steps of 64K up to a total memory size of 192K. The high-resolution graphics mode really is high resolution with 248 by 256 pixels.

Excellent track-record

The Lynx is based on the Z-80A microprocessor, which has an excellent track-record as the chip at the heart of the Sinclair Spectrum. The choice of processor has a number of implications. First, and probably in the long run, most importantly, it means that the Lynx is CP/M-compatible.

CP/M is the operating system most widely employed by the larger microcomputers used



in business. It handles files of data on the floppy discs those larger micros use. The most important thing to bear in mind is that in theory a program written in CP/M on one machine can be transferred to another machine with the minimum of fuss.

Of course in practice there is nearly always a good deal of fuss, but it does allow the user access to thousands of computer programs and systems, as well as a growing number of databases that are being made available on CP/M. CP/M is far from perfect, but it is the operating system that comes nearest to ironing out all the differences between various microcomputers.

To run CP/M, a computer needs a minimum of 64K of RAM — hence the importance of the ease of memory expansion on the Lynx. The upper limit of 192K means that some very substantial software packages will run on the machine.

Most people thinking of buying a Lynx will probably not be interested in CP/M software immediately. It is, however, very reassuring to know that should your hobby ever become more than just that, you will not have to throw your Lynx away and buy a new micro.

The second significant implication of that Z-80A processor is that it makes the Lynx a possible upgrade for those ZX-81 users who do not want a Spectrum. The Lynx is more powerful than the Spectrum but then it costs £50 more. But what will attract people is a simple-to-use machine-code facility.

Machine code is the language a computer uses internally, as opposed to the Basic which is really there for the benefit of humans who, unlike computers, do not normally think in binary. When a program is written in Basic, each line has to be converted into machine code every time it is acted on, and that conversion takes some time. As anyone who has played a machine-code game will be able to tell you, machine code works much faster than Basic.

The monitor in the Lynx's ROM allows the user to write and edit programs written in machine code. It also means one can save and load these programs to and from tape. The other advantage of machine code is that programs require far less space than Basic programs — and with 48K of RAM at your disposal, some substantial programs can be written.

Code-shy manual

The manual rather coyly shies away from the subject of machine-code programming. There is a chapter on the subject, but this is only for those who already know something about it.

Some interesting commands are available to the brave souls prepared to grapple with machine code, all of which are available from Basic. This means that the main part of the program can be written in Basic, with machine-code routines handling those features which require speed, such as graphics or sound. Not only is there the Poke command — which will be familiar to experienced programmers — but also the DPoke command which Pokes to two bytes at a time.

Music-making

The command Code allows you to store machine code in a Basic line. LCTN is in effect a pointer to the first byte of machine code stored in a Code line: it is used like an ordinary variable. Type Call to tell the computer to execute the machine-code subroutine held in one of the Code lines, which is specified by LCTN.

Bytes of data can pass into and from the Lynx via the I/O port at the rear. This can be done using the commands INP and Out. The music-making facility of the Lynx is limited when in Basic. A Beep statement is all that is open to you. This is a major disappointment on a number of counts.

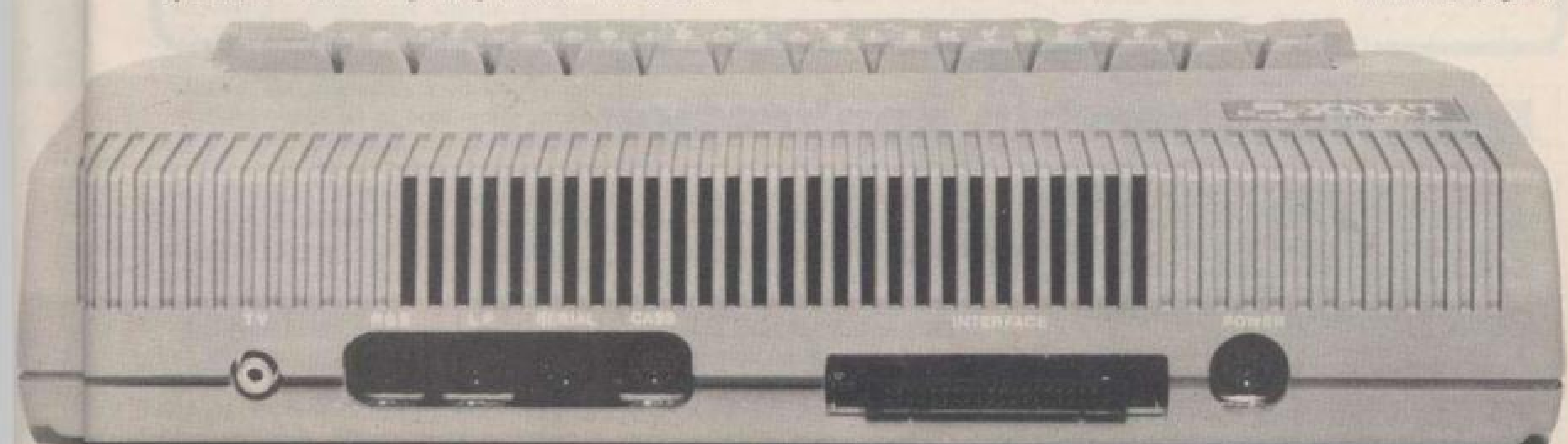
First, the box in which the Lynx is supplied promises a digital-to-analogue sound converter. This turns out to be little more than a small speaker. The Beep statement also disappoints because rather than entering a note name — or even a number corresponding to a particular note — you have the following format:

```
BEEP wavelength, number of cycles, volume
```

The volume can be any number between 0 and 63. To be able to hear anything you are obliged to use 63 all the time, which is regrettable as it reduces the flexibility. The wavelength and the number of cycles have to be calculated beforehand. Furthermore, I am not convinced that the wavelengths are that accurate in practice.

If microcomputer manufacturers paid a little more attention to the sound possibilities of microcomputers, the results would be astounding. A good example of this is the way in which sounds can be "synthesised" using

(continued on page 45)



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(continued from page 43)
machine code on the Lynx.

The Sound command is a good idea, which allows interesting possibilities, but a few Basic statements could be a more powerful. Sound works by outputting a number of bytes of memory through the speaker. With a memory of 48K, relatively complex sound patterns can be acheived. Sadly there is only one voice channel, but even with this restriction good effects are still possible.

Speech synthesis

Speech synthesis is also a feature according to the manual, but the output is so quiet that you may never hear it. By connecting a analogue-to-digital converter, the Lynx could take noises, store them in memory and replay them. Even processing of stored sounds is possible. I managed to synthesise white noise by feeding the loudspeaker a series of random numbers.

The documentation concerning the Sound command is woefully short in the manual. For a command like this giving no examples is really not good enough. More to the point, those who use the Beep command are not even given a list of which wavelength corresponds to which note in the musical scale. On the whole the manual is not as comprehensive as it should be.

It is a glaring failing for a home computer manual like this one not to have a proper index which allows users to find the information they require quickly. It might be right to omit information which is readily available elsewhere, but I cannot see why facts relevant to the Lynx are missing. As a teaching manual, for someone who wants to learn about computers, it is adequate, and certainly better than the Dragon manual.

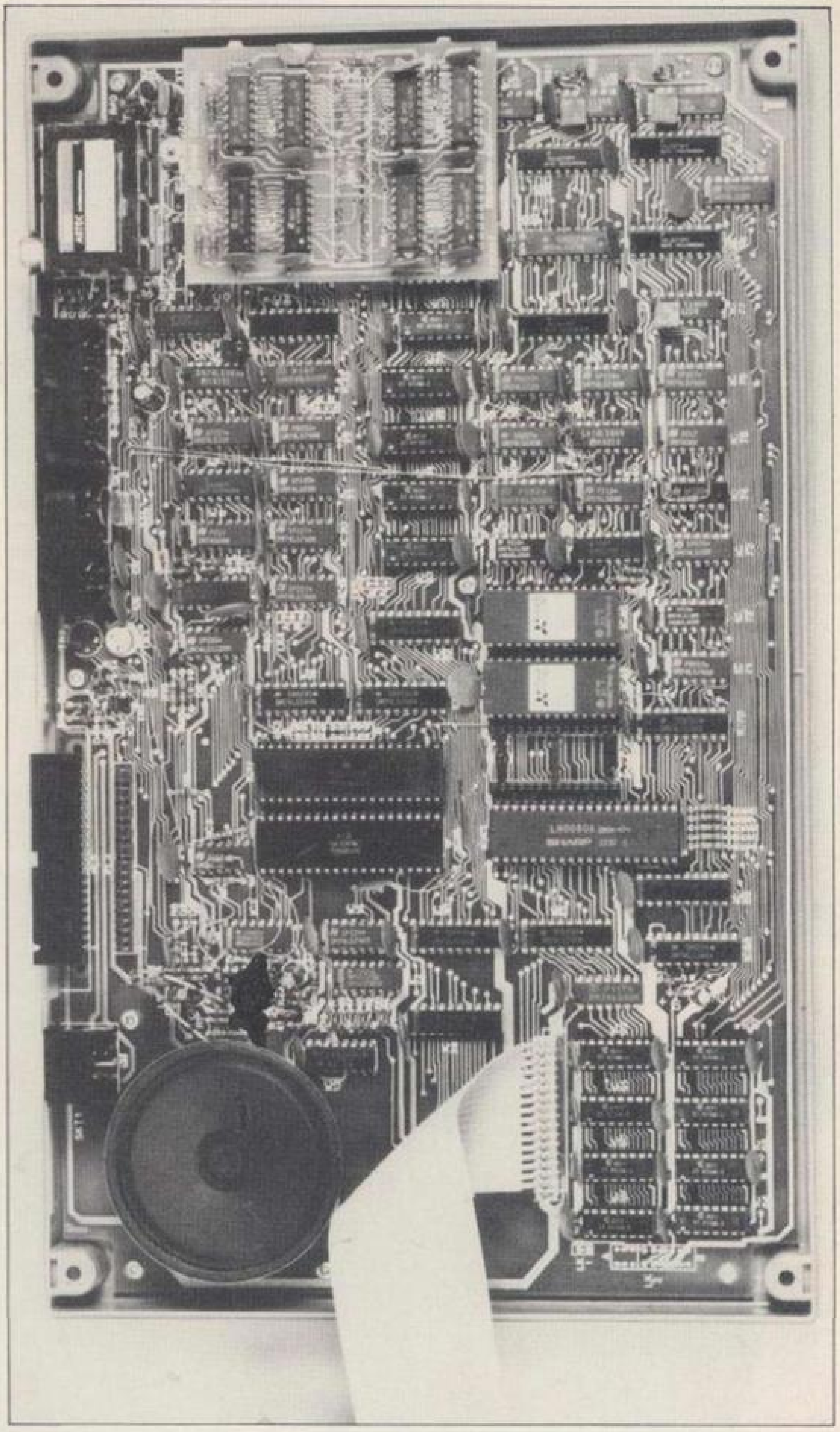
The Lynx has a number of commands and language features not seen elsewhere, giving the machine a particularly strong, if a little odd, version of Basic. I like the structures, Repeat-Until, and While-Wend. They give Basic a class not normally associated with it. I also like the automatic indenting. It really does make programs easy to read and, more importantly, easy to debug.

Old favourites

Lynx Basic has all the old favourite commands, including the now essential Trace to let you know where things have gone wrong. Swap is interesting as it allows you to swap the values of two variables. Pause will hold up the computer for a specified amount of time. UPC$ is a string function that converts all the letters to upper case.

Among the commands used in the tape operating system are Append which permits you to add subroutines to the end of a program, and MLoad which loads machine code from tape. The baud rate can be selected using the Tape command. Like the BBC micro, the Lynx allows Procedures, which will keep the educationalists happy — they like structured programming.

The graphics on the Lynx are perhaps its strongest feature. Resolution is high, and unlike most other home computers all eight colours can be mixed on the same screen. There are 256 by 248 pixels, and a good set of commands to use them to create some very good graphics.



Window is a strange command which disables part of the screen, allowing writing only within the window area specified. Print@ allows printing to start at any given pixel location on the screen. This means it is possible to print subscripts and superscripts, a useful facility for writing mathematical or chemical formulas on the screen.

There are commands which let you play around with the cursor, and a VDU command which is not as complicated as the BBC VDU command.

CONCLUSIONS

- The Lynx is an attractive little machine, but offers nothing spectacularly new.
- It is good value, and does have some very interesting expansion possibilities — especially when it becomes part of a CP/M system.
- The real keyboard, high resolution, and machine-code monitor make it a natural "next computer" for people wishing to upgrade on last year's model. ■

ORIC 1

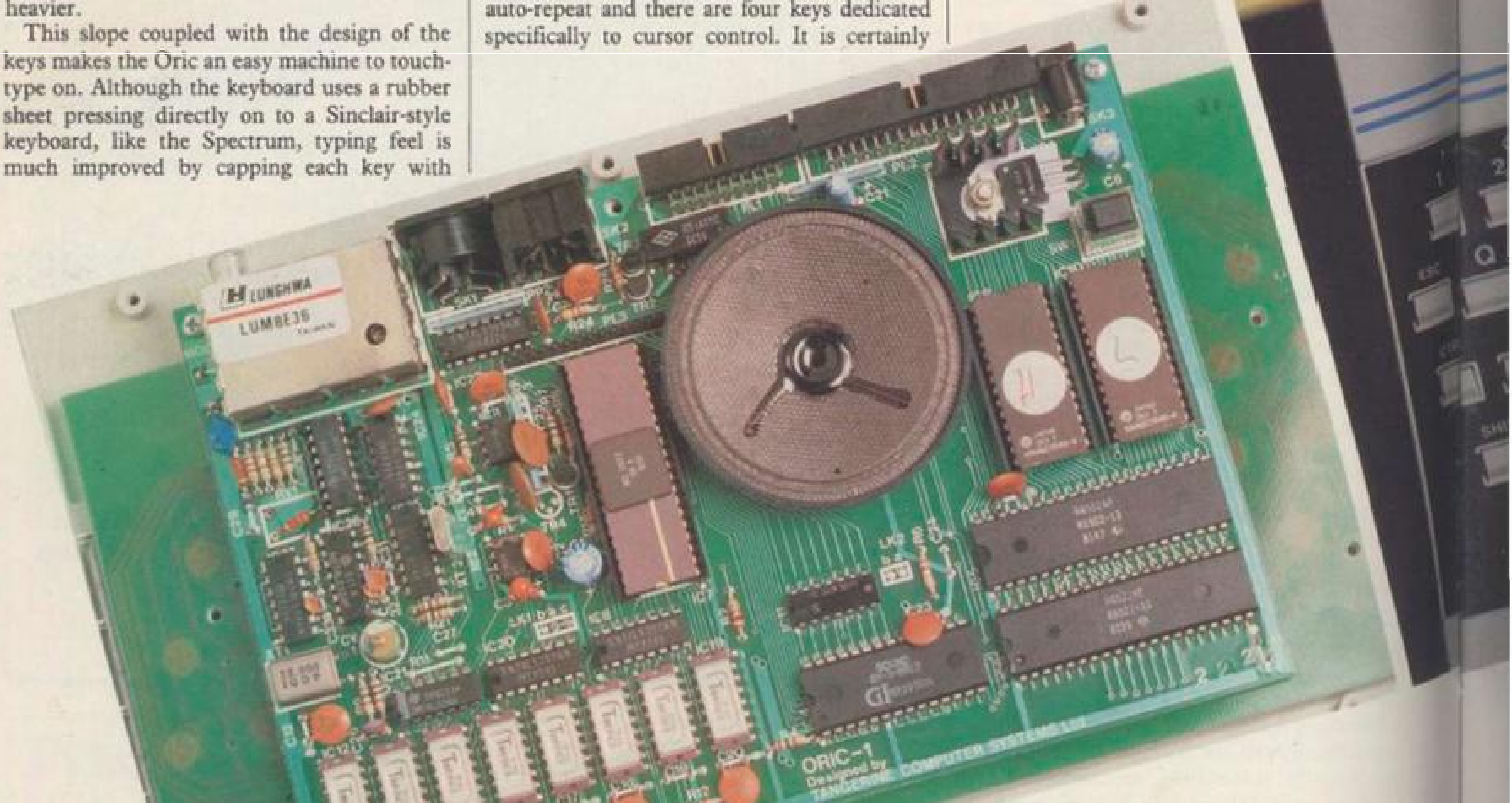
ORIC IS EVERYTHING you hoped it would be. Alive with colour, and zapping with built-in sound effects, the Oric looks like a match for any machine now selling for less than £200. Oric is also everything you feared it might be — just when you thought it might be safe to go back into home computing.

The £99 16K colour computer is the first to break the £100 barrier. Outwardly there is nothing to distinguish it from the £169 48K version. Both are grey plastic wedges measuring 11in. by 7in., designed to present the keyboard at the same angle of attack as a typewriter. Height is 0.75in. at the front rising to 2in. at the back. Overall the Oric is half as big again as the Spectrum and 50 percent heavier.

This slope coupled with the design of the keys makes the Oric an easy machine to touch-type on. Although the keyboard uses a rubber sheet pressing directly on to a Sinclair-style keyboard, like the Spectrum, typing feel is much improved by capping each key with plastic. Not only does this remove the "dead flesh" feel but it also gives the impression of positive click keys. A note sounds every time you depress a key, with a lower note distinguishing return and control keys — but if you do not want to sound like the telegraph operator in a bad western Control F turns off this keyboard bleep.

Layout of the keys is relatively standard and as the Oric does not have single-key entry it has been possible to label them clearly. The white on black lettering is not pretty but it is unambiguous. Although the keys are quite small except for an oversize return key and a full-size space bar, overall the Oric emulates the feel of a portable typewriter. All keys have auto-repeat and there are four keys dedicated specifically to cursor control. It is certainly easier to type on than any of Sinclair's offerings.

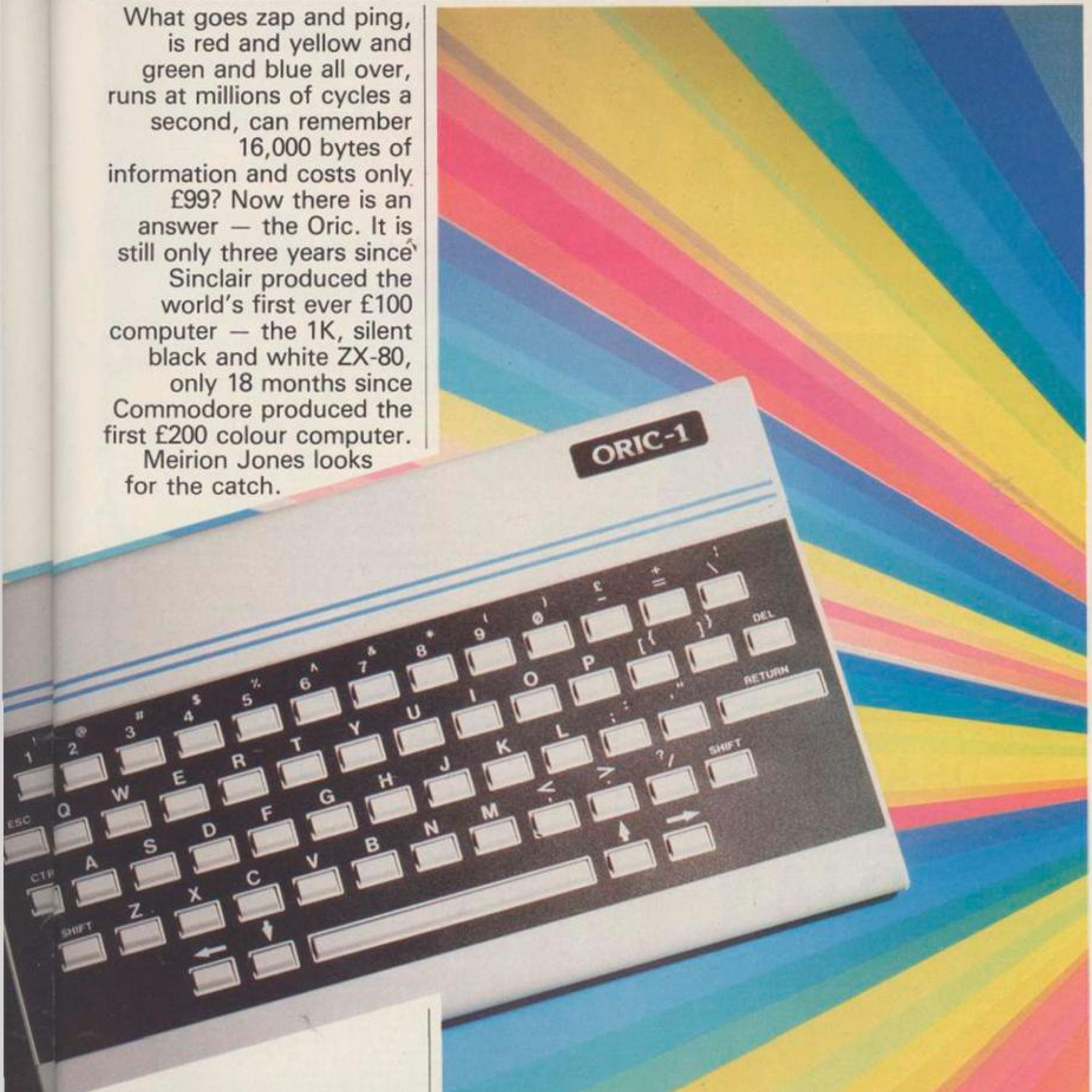
Switching on the Oric produces a screen display of a white screen with a black background. Black lettering informs you that you are in Oric extended Basic O 1.0 © 1983 Tangerine, followed by the number of bytes free and a ready message. If you Control T into capitals the message Caps appears in white just above the top right-hand corner of the white box. Likewise if you are loading a program from cassette by CLoading "Name" the message Searching appears in white just above the top left-hand corner.



REVIEW

When you want to break out of dreary monochrome the Ink and Paper commands allow you to choose your own foreground and background colours. Numbers 0 to 7 offer you black, red, green, yellow, blue, magenta, cyan and white. Colours are comparable in quality with the Spectrum but there is no facility to change the border colour. The control key gives access to double height and flashing characters.

What goes zap and ping, is red and yellow and green and blue all over, runs at millions of cycles a second, can remember 16,000 bytes of information and costs only £99? Now there is an answer — the Oric. It is still only three years since Sinclair produced the world's first ever £100 computer — the 1K, silent black and white ZX-80, only 18 months since Commodore produced the first £200 colour computer. Meirion Jones looks for the catch.



Drawing on the Oric is not difficult. Typing Hires gives access to the 240 by 200 maximum resolution of the Oric. You can work in two colours at a time in Hires but you have the bonus of three lines of 40 characters outside the main Hires screen. Curset X,Y,Z sets the cursor to an X,Y co-ordinate on the screen while Z specifies the foreground or background colour. Curmov is like Curset except that X and Y are relative to the last position of the cursor. Draw X,Y,Z draws a straight line from the current cursor position to a point X across from it and Y down. The circle command takes the form Circle R,Z where R is the radius and Z is again the fore-

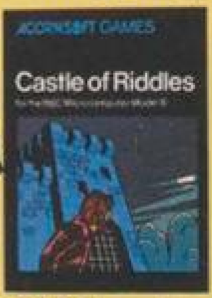
(continued on page 49)

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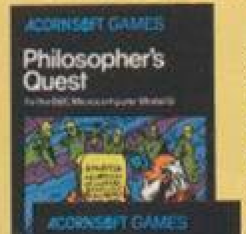
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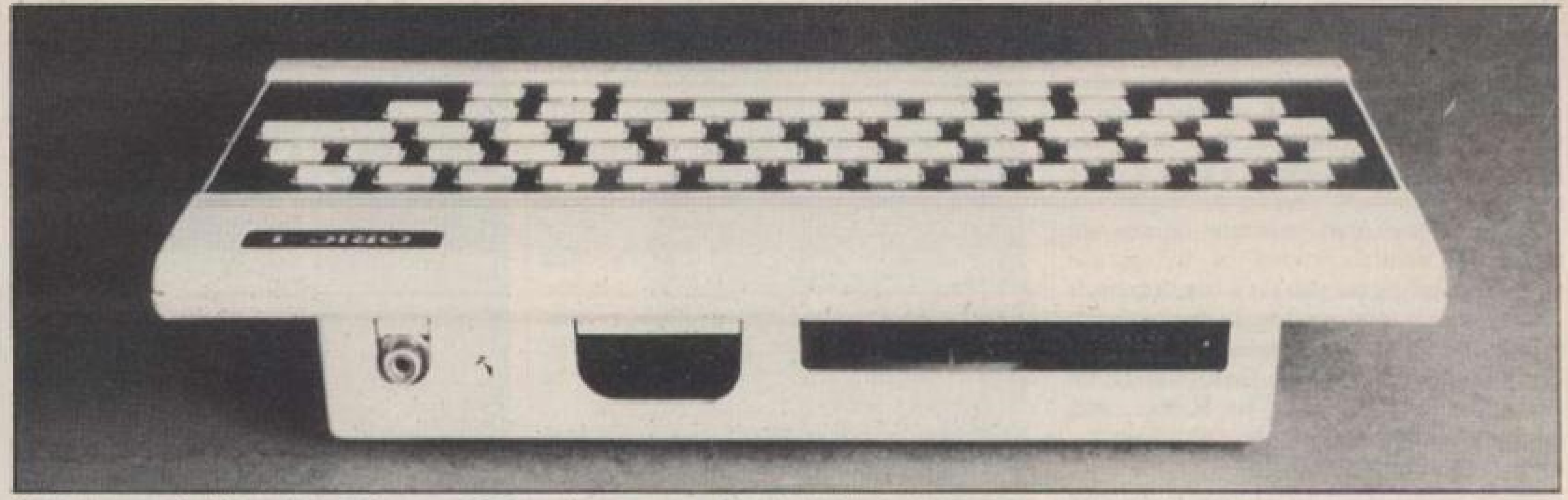
Your flexible friend. By using the printer buffer for temporary storage this program allows you to format output as required. Its output is a clearly defined 12 CHARACTER mnemonic although 9 will suffice. This can be printed to the screen in one or more columns, or to the ZX printer, into an array for later printing, or use it with your M/CODE loader program. All 1,2,3 and 4 BYTE Z80 op-codes handled. Also included are the calculation of both absolute and relative addresses plus SPECTRUM RST literals. Switch literals on and off to print TABLES and other FLAGS. Complete with a demo program in order that you may extract the best from this excellent program. This may be the key to your understanding of the SPECTRUM. JUST 1500 bytes of fast M/CODE it's flexible and will even disassemble itself. JUST £5.50. INC.

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WORK FORCE
140 WILSDEN AVE, LUTON, BEDS.



Back view reveals, left to right: TV output, RGB monitor, cassette, Centronics interface, expansion port and power input.

(continued from page 47)

ground/background colour. The Fill command operates over 40 cells in 200 rows, but there is no Paint command as on the Dragon. A Pattern command allows you to draw dotted lines of any sort.

Char A,S,Z allows you to type text on to screen in Hires somewhat painfully. A is the ASCII code of any letter you want to print and Z again the foreground/background colour. S can be either 0 for standard character set or 1 for the alternative teletext-style character set which the Oric carries in readiness for the £79 Modem which will connect it with Prestel and the outside world.

The Oric normally saves at 2,400 baud but it also allows you to save at 300 baud for extra security. Machine-code subroutines can be saved by specifying start and end addresses. You can also Auto-save so that your programs will run as soon as they have loaded.

What marks the Oric out from some of the older machines is that it has been designed with an awareness that 1983 will see computers being used increasingly for practical purposes. The built-in Centronics interface will make it easy to plug in a printer or other peripherals. Oric will soon be selling a Modem so that Prestel will become available. Owners will be able to accept telesoftware — programs loaded straight down the phone line — eventually electronic mail could come into the home by the same route, and with the addition of a tape recorder the Oric with its Modem could become a telephone answerer and message taker.

Forth on the way

An RGB output allows you to power a monitor if the television display does not meet your exacting standards. An expansion socket accepts plug-in ROM cartridges for games or for other languages such as Forth, which is being written for the Oric at the moment. There is some confusion as to whether the Oric will accept joysticks but the four cursor keys and space bar all in a line are ideal for games which pit one human at a time against the computer.

The Oric is based around the 6502 processor so the internal workings should not frighten anyone used to conversing in hex with an Acorn Atom or BBC or for that matter a Vic-20. Unfortunately it may dissuade Z-80 machine-code enthusiasts from moving up from their ZX-80s and ZX-81s.

The Basic is a relatively standard Microsoft but the lack of single-key entry should not deter beginners. Editing is made easier because the delete key does not require a shift. Control X deletes the line you are entering and entering Edit puts you in editing mode. Edit line number sends the cursor to that line where it can be controlled with the arrow and delete keys. Escape allows you to insert characters into the edited line. List only lists specified lines or the whole program but can be controlled with Control S.

A good speaker and built-in noises get the Oric's sound off to a good start. Typing Zap, Ping, Shoot or Explode produces convincing arcade game noises which can easily be incorporated into any program. Control G produces a continuous ringing sound. Instead of the mumblings of the Spectrum the Oric delights in Sound, Music and Play commands. Sound and Music define the type of sound while Play shapes them. Sound consists of noise channel which can be mixed with any of three tone channels at any of 15 fixed volume levels — or a variable volume level to be defined by Play. It also defines the period of the sound. Music gives a choice of notes across six octaves. Play enables noise and tone while offering seven choices of envelope to shape the sound.

One of Oric's backers is British Car Auctions but, if they thought they were moving into an area of business with a better reputation with consumers than selling second-hand cars, computing may not have been the best choice. It would be unfair to single out Oric Products International because many of the people who have now waited three months for the Orics they ordered on 28 days' delivery only ordered one because they had given up on ever receiving the Spectrum they had ordered when Acorn failed to deliver the BBC on time.

Not enough thought has gone into the simple things. Detail changes to the design could have made the Oric look far more up to date. The mains lead from the built-in transformer in the plug is annoyingly short and the plug into the back of the machine is so shaky that unless it is taped into place you could lose whole programs that you have painstakingly typed in. Doubtless Oric will soon put these details right and produce a proper manual. It would be a pity if a good machine at a bargain price were to be spoiled for a ha'porth of tar.

CONCLUSIONS

- With 16K for £99 and 48K for £169, Oric 1 remembers more for less money than any other colour computer.
- Oric offers six true colours in addition to black and white. Any two can be used in high resolution.
- Sound is loud and clear — not just a muddy bleep. Channel, octave, note, period and envelope can all be controlled. Built-in sound effects will be useful for games.
- The keyboard is an improvement on the Spectrum's but a real typewriter keyboard would have been much better and would, perhaps, only have added another £10 to the price.
- The Oric has been designed for the real world. A built-in Centronics interface makes it easy to plug in printers and peripherals — whereas Spectrum buyers will have to pay £20 for an RS-232. Oric's Modem should also be available months before Sinclair's.
- Oric's first manual was disastrous — it was clear that the writer had never laid eyes on an Oric. The manual has been corrected, and is now merely inadequate. The full manual should be available in the near future.
- The 6502 CPU is already familiar to Acorn and Commodore specialists so there should be no shortage of software.
- Once teething troubles have been overcome the £99 Oric will become the ideal beginner's machine.
- Oric lacks single-key entry but this a mixed blessing, and the Basic is conventional.
- Problems with fluctuating modulators may cause production delays. Sinclair cannot hope to bring out the ZX-83 much before autumn this year — but if the Oric becomes a threat he might alter the specification of the Spectrum or cut its price. Potential Oric buyers should also remember that the Electron and the Binatone may appear soon. ■

ATARI

Jack Schofield scans the screen for quality as he tries his hand at the latest Atari games.

THERE IS NO doubt in some people's minds which micro has the best games — it has to be the Atari. But the games are more expensive than the average, which makes it very important to try before you buy. Who can afford to spend £20 or £30 on a game and not play it?

Many of the Atari computer games are reasonably accurate copies of the arcade versions. That means that for a few pence you can try arcade versions first. In this category are Centipede, Pac-Man, Defender, Asteroids, Space Invaders and Missile Command, all by Atari, and Midway Gorf by Roklan, and English Software's Airstrike, which is a version of Scramble.

Arcade games are fast and furious, because they are designed to extract another 20p from your pocket as quickly as possible. Home computer games can on the other hand be much more challenging and absorbing to play. Examples are Atari's Star Raiders and Eastern Front 1941 and from Thorn EMI, Jumbo Jet and Submarine Commander.

Star Raiders, held by some to be the best computer game of all time, has four skill levels, and the novice level bears about as much resemblance to Commander level as draughts bears to chess. Learning to play a good game at the top level takes months of effort.

Eastern Front 1941 — written by Atari's Chris Crawford, who also wrote Tanktics, Avalon Hill's Legionnaire and Atari's Scram — is a war game. You command the German armies fighting the Barbarossa campaign against the USSR. The graphics are impressive: the map is about 10 screens big and you can use the joystick to scroll over it in any direction: this is single-pixel scrolling.

The computer plays an extremely intelligent game, and the results can be incredibly accurate historically — the Russians always win. Unfortunately it takes about three hours to play, and there is no way of saving or loading a partial game.

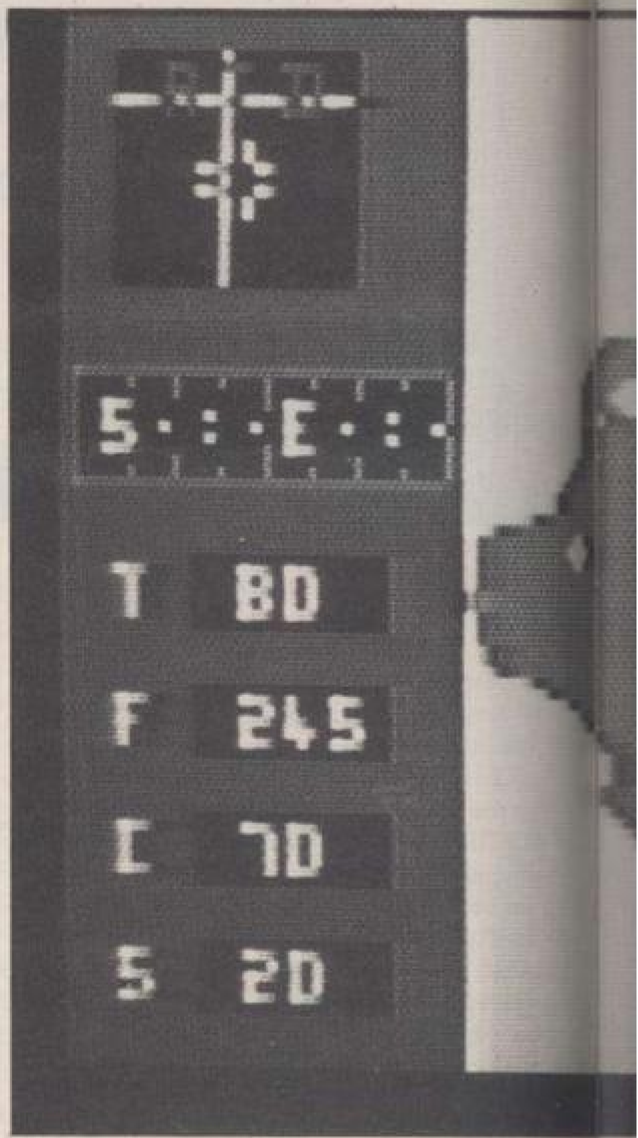
If you like the arcade versions of Pac-Man and Missile Command then you will like the home versions. I found Asteroids somewhat disappointing, but then I also disliked the arcade version. Centipede, however, is certainly very addictive.

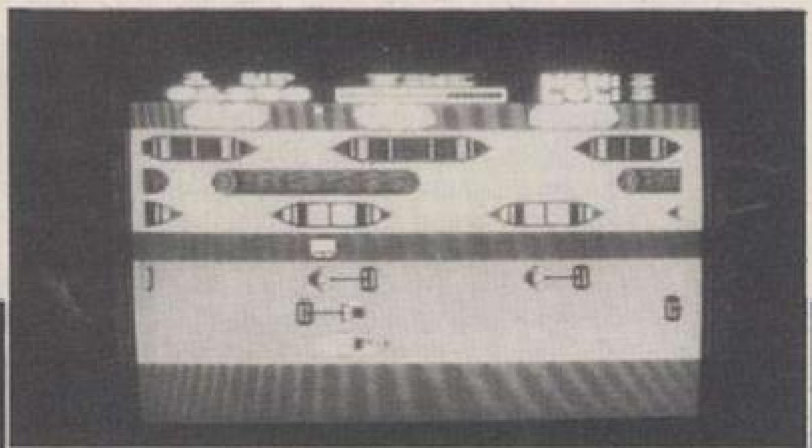
The game is simple. You have a bug-blaster at the bottom of the screen, and you kill centipedes — segment by segment — as they wind their way down the screen. Meanwhile you are obliged to avoid being hit by prancing spiders or bombed by frantic fleas, while simultaneously trying to pick off passing scorpions. All the play takes place in a field of mushrooms.

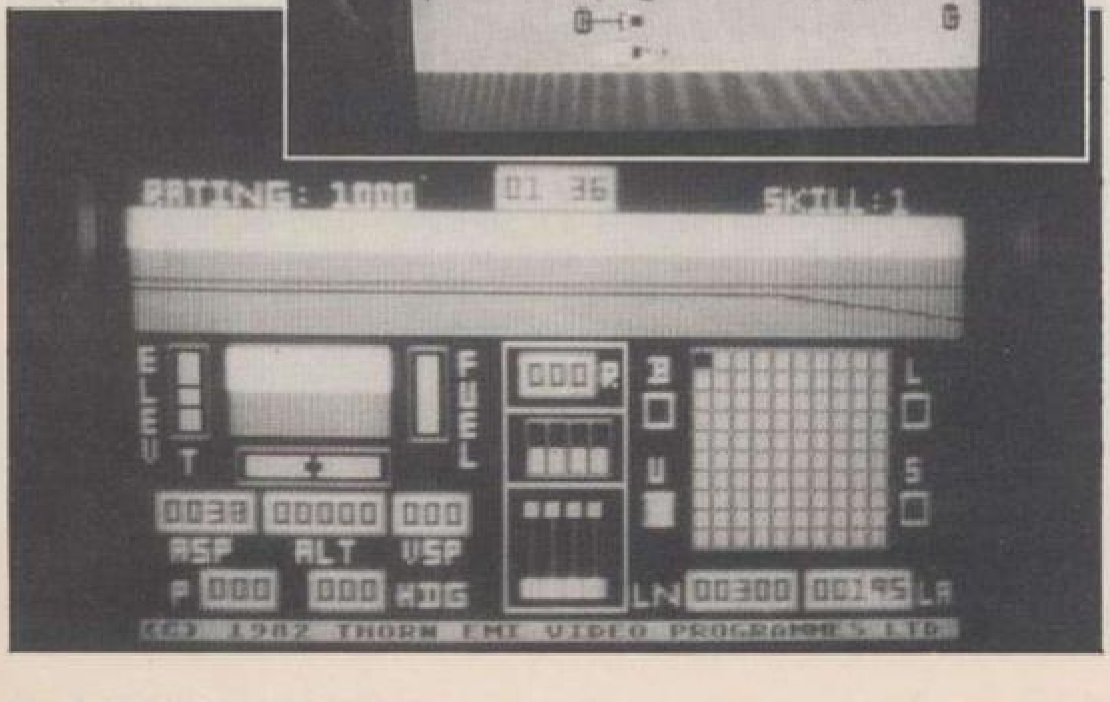
You get an extra bug-blaster and a neat tune for each 10,000 points you score, so in theory the game could last forever. In practice the action gets faster every 30,000 points, until by 120,000 everything is frantic, not only the fleas.

The sound is excellent. Each insect has its own little tune against a throbbing background noise that is even more compulsive than the arcade Space Invaders.

All the Atari games mentioned, except Eastern Front, are plug-in ROM versions. This means they are very quick and easy to load, and any Atari owner can play them. Eastern Front needs 16K and can be bought on cassette or disc. Star Raiders and Eastern Front are one-player games, while all the others can be played by two people in competition. All the games are joystick-operated, though Star Raiders also uses about half the keyboard.







Frogger-variant Preppie's garden setting, right, seems a million miles from suburbia with no plastic gnomes and three lanes of man-eating lawnmowers. Jumbo Jet, below, is a complex flight simulator.

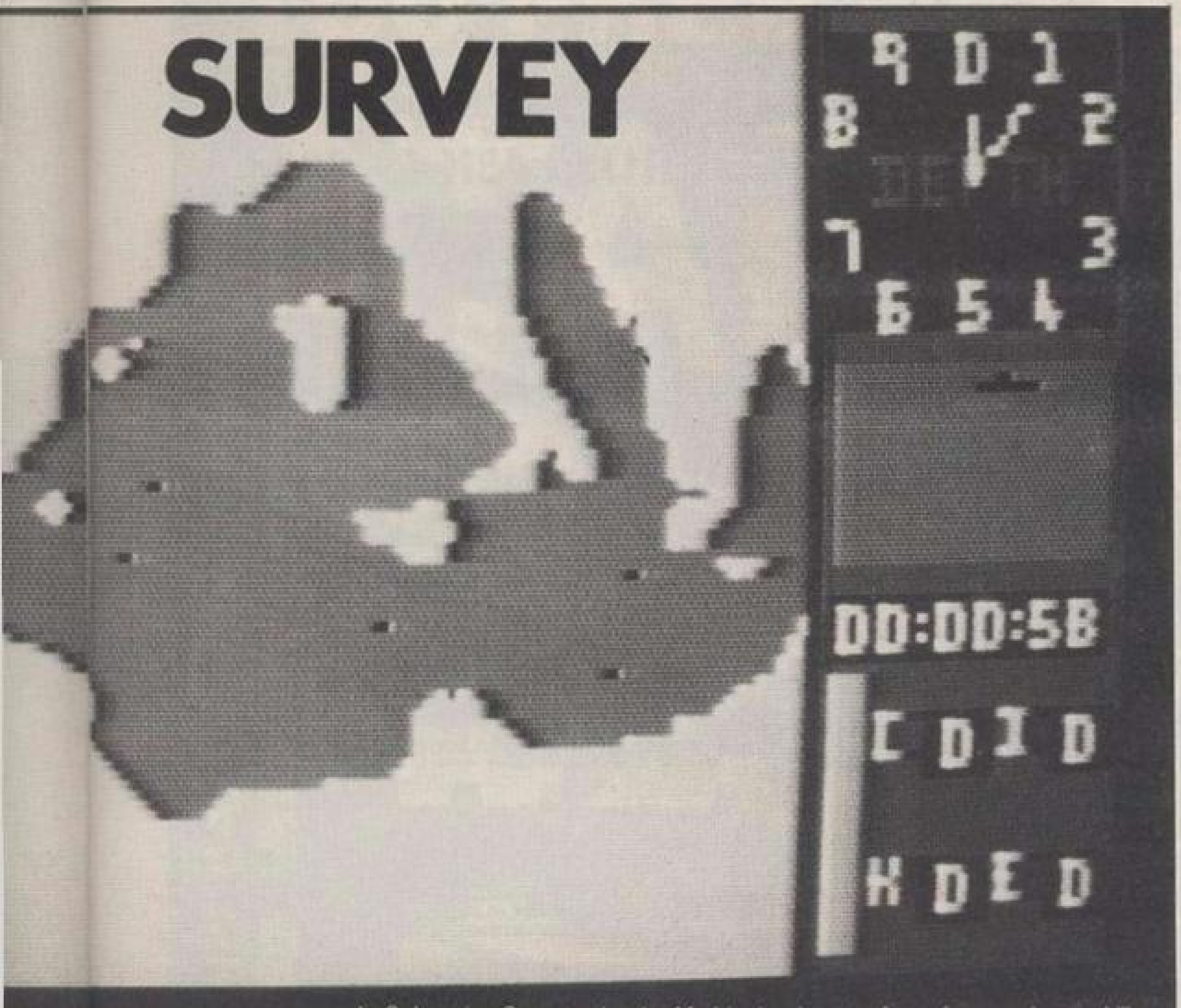
The independent games are necessarily in the number two position, and as such should try harder. Roklan's version of Midway's arcade game Gorf is a case in point. The graphics are recognisable as Gorf, and there are four different variations — invaders with force-field barrier, laser attack, space warp and mothership. But the pace is a little slower than the Atari version.

Airstrike from the English Software Company is a home version of the arcade game Scramble. It is hard to manoeuvre the joystick-operated needle-fighter across the tiny landscape of the home version. The rockets that take off as you fly by are very easy to dodge, you just accidentally run into walls all the time. Also, the bomb release is the space bar of the computer which presents problems as you need two hands to work the joystick. The graphics are not quite as good as some of the other arcade games tested.

Protector, from Synapse Software, is very similar in many ways, but much better. You fly a needle-fighter across a horizontally-scrolling landscape, but the action is much smoother and the graphics are better drawn. In Protector, you have to rescue people from a city, fly them to another city, and have laser fire to reach home base.

Meanwhile the enemy ship is also picking people up and dropping them into a volcano.

SURVEY



In Submarine Commander the Med is the theatre of war for your hunter-killer.

SOFTWARE

You have to race against time as the volcano eventually erupts and destroys the cities. Because of the graphics it is fun to play at first, but it lacks the speed of Centipede or the challenge of Star Raider.

Preppie from Adventure International — which produces the Scott Adams Adventure games for the Atari — is a Frogger-type arcade game. The graphics are smooth and colourful, and the sound is musically the best I have ever heard on the Atari.

The idea of Preppie is that, with a joystick, you control an American schoolboy picking up golf-balls. Instead of a highway you have to cross three lanes of lawnmowers and a three-lane river with boats, logs and alligators. The game is a great demonstration of the Atari's sound and graphics capabilities.

Bandits is an arcade game from Sirius Software, and requires 48K and a disc drive. That puts it beyond some Atari owners, which is a shame as it is an excellent game. This is not a home version of an actual arcade game, though the movement of the enemy raiders is very like that in Galaxian. Your role is to defend a lunar supply base against waves of a dozen enemies who swoop down, snatch fruit and carry it off to their own flying saucer. These enemies are not the usual Invaders but are like fruit flies, bees and so on.

Probably this game, by Tony and Benny Ngo, has been translated from an Apple version. On the title page you start with an Apple, then a bug flies up and munches it down to an Atari logo. The game is full of amusing touches like this, plus some fancy chequerboard graphics, but unfortunately these slow down the play.

Finally, I tried two discs from Broderbund software, who are justly famous for their Apple games. I was really looking forward to playing Choplifter but the disc refused to boot. Broderbund's Stellar Shuttle loaded, but after every read made a horrendous scrunch. It took a long time too. Frankly I thought Stellar Shuttle was poor — a sort of "Lunar Lander meets Asteroids" — and I shall be circumspect about Broderbund games, as long as they make this kind of racket. Presumably it has something to do with the software-protection routine.

Simulations are a fascinating area of computer games, and they have educational interest too. Just as pilots now learn to fly in simulators, perhaps we will all use this method of learning in the future.

Thorn-EMI's flight simulator Jumbo Jet, and simulation games Submarine commander and Soccer are all supplied on ROM packs so they are "plug in and go". Unfortunately they are not "plug in and play".

Jumbo Jet Pilot is a simulation rather than an game, and takes an extremely long time to play. The first time it took me nearly 25 minutes to taxi the plane on to the runway and take off, after which the "ground" came into view at 45° and I crashed. "Try again" appeared. Submarine Commander takes even longer.

The Jumbo Jet screen has an instrument panel with indicators to watch. Submarine Commander has slightly fewer, but the central area of screen offers three options: map, sonar and periscope views. Thus you can track a ship on the map, dive and home in using sonar, then nearly surface and watch your torpedoes strike home using the periscope. It is a real challenge.

With both games the action is slow, and requires a good deal of forethought. You have to consider your course carefully, because, for example, it takes a long time to put about a sub. It is an inherent problem with simulations — the more accurate they are, the less game-like. These are accurate.

One limitation is not inherent: the quality of the handbook. Both Jumbo Jet and Submarine Commander are harder to start playing then Star Raiders, and need top-quality instruction books like that one has. The Thorn-EMI efforts are inadequate. No doubt when you have played the games a few times the handbook becomes irrelevant, but in terms of helping you to start they do a very poor job indeed. It is a shame that what is obviously brilliant programming is let down in this way.

Game	Manufacturer	Medium	Number of players	Price
Star Raider	Atari	ROM	one	£28.95
Eastern Front (1941)	Atari (APX)	Cassette or disc	one	£21.95
Centipede	Atari	ROM	one or two	£28.95
Gorf	Rocklan	Disc or ROM	one or two	£26.95
Airstrike	English Software	Cassette or disc	one or two	£19.45
Protector	Synapse	Cassette or disc — 32K minimum	one or two	£20.80
Preppie	Adventure International	Cassette or disc — 24K for disc	one or two	£19.75
Bandits	Sirius	Disc — needs 48K	one	£23.95
Choplifter	Broderbund	Disc — needs 48K	one	£23.75
Stellar Shuttle	Broderbund	Cassette or disc — 32K for disc	one	£19.75
Jumbo Jet	Thorn-EMI	ROM	one	£34.95
Submarine Commander	Thorn-EMI	ROM	one	£34.95
Soccer	Thorn-EMI	ROM	one to four	£29.95

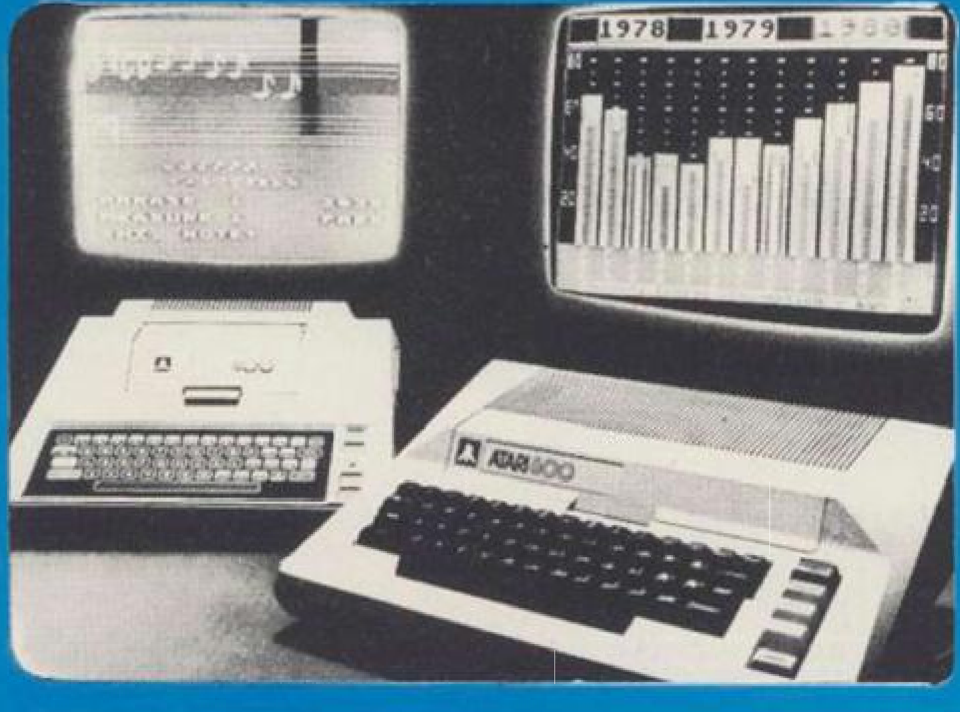
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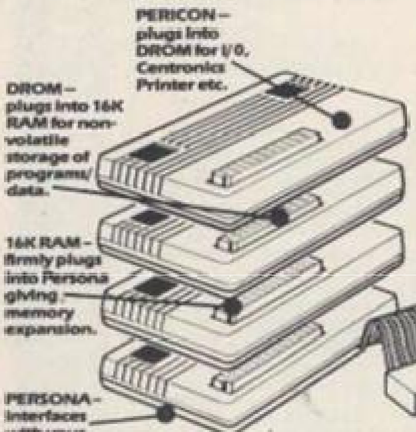
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Sound effects for your ZX81 are now available at a price you can afford! Zonix is a hardware/software combination that allows you to write programs with real impact. The software includes two programs:

a) A program set to produce bombs, missiles, fire engines, tunes, telephones and sirens. Also includes the facility to make your own.

b) A program that turns your ZX81 into an electronic organ.

The hardware is an amplifier with volume control and loudspeaker which simply plugs into the mic socket of your ZX81. The sounds can be actuated from within your programs with a simple command. They can also be of various lengths so the limit is only your own imagination.

MCoder — £7.95

This truly amazing program is the most flexible compiler available for the ZX81 AND NOW THE SPECTRUM TOO!.

MCoder will instantly translate your slow basic programs into super fast machine code at the touch of a key. It is also extremely easy to use: just load MCoder (the ZX81 version is just 2K long, the spectrum versions 3K) and then write your basic program as normal or you can load a basic program from tape to save you retyping the whole thing. MCoder then allows you to run and debug the basic until it is fault free. Now you can bring MCoder into operation using a print USR command – the basic will then be compiled into machine code as you watch!.

On average MCoder will increase the speed of basic programs 75 times. Both the ZX81 and the spectrum version will handle 95% of all basic commands and is quite simply the best compiler on the market. state 16K or 48K when ordering spectrum MCoder.

DRAGON 32K

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Dragbug is a powerful machine code monitor plus a full disassembler for your Dragon 32. An essential software tool for writing, debugging and running your machine code programs or machine code subroutines to be called from basic.

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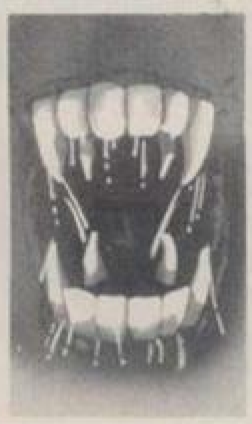
If you've ever played defender or scramble just wait till you play Attack! Incredibly fast !!!

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The news is that QSAVE has been improved for '83

This is what you get:

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2. Highly sophisticated software which will load and Save programs at 16 times their normal speed (i.e. 8K in 10 secs; 48K in 110 secs). Programs can be named to allow a superfast file search through a tape. It works equally well with autorun programs, Basic or machine code.

A **TRUE** verify feature is also provided – this allows you to verify that a 'SAVE'd program has 'SAVE'd properly **BEFORE** turning off the power and finding all is lost. QSAVE will operate with **ANY** memory, on **ANY** program length **AND** with your existing programs. **All the above is contained in ½K of superbly easy to use Software.**

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Although nowhere near as profuse as Spectrum software, various add-ons have now appeared to bridge the gaps in the micro's specification. Tim Langdell reviews.

IT IS ALMOST a truism to say the Spectrum has been pushed to its limits. A great deal of time has been devoted by software houses to creating programs that put more sophisticated machines with less well-thought-out software to shame. Nevertheless, there is scope for peripherals which even up some of the Spectrum's primary hardware inadequacies.

Under control

Following up its success with a controller —that is, a device which allows you to switch between Loading and Saving, disconnecting the computer when saving and vice versa — Abacus has introduced one for the Spectrum. This means more reliable Saving and Loading. Unlike the ZX-81 version, the Spectrum controller also includes an amplifier, a particularly useful feature in view of the Spectrum's own weakness in amplification. Setting up the controller simply requires plugging the Spectrum's power supply into the side of the Abacus box and the power lead from the box into the back of the Spectrum. The Mic and Amp leads are used to connect the Spectrum to the tape recorder.

Kempston's joystick is a standard design with fire button and control stick working on a switching rather than analogue base.

This means that it can be used to simulate the detection of keypresses. The joystick is mapped to Port 31 of the Spectrum, and can be accessed with the In command.

The value returned by detecting Port 31 in this manner can be between 0 and 26 with the eight directions from forward through NE to E, SE, S and so on being values 1 to 10 — omitting 3 and 7 — and the fire button returning 16. The joystick can be read in machine code too for a faster response and arcade-like action.

The joystick's connector is a small black plastic box with two matt-black TTL chips visible on the outside which plugs straight in to the Spectrum's printed-circuit board. The joystick itself is very responsive. My only quibble is that a spring-back-to-centre mechanism would make the central off position easier to reach when playing fast arcade games. The joystick costs £19.50.

This company has also brought out one of the first 24-line I/O ports for the Spectrum. Simply constructed — a single TTL chip supports the operation of the 8255 PPI chip — the board comes with clear documentation which indicates how one can use the three 16-pin dual in-line sockets or a 24-way edge-connector attached to the back of the printed-circuit board. The 8255 chip has several modes of operation: the three I/O ports can be configured in the following ways — setting up one bank as inputs, another as outputs, with the option of "handshaking" on port C.

Using the In and Out commands the port can be accessed from both Basic and machine code. Apart from the back-to-back edge connector the port can be limited to the Spectrum with a stackable edge-connector, or a motherboard. The stackable edge-connector allows an extra device to be attached to the Micro whilst the PPI is attached. The motherboard will take two cards in edge-connector sockets as well as a Printer or a Microdrive. The motherboard is supplied with its own 5V regulator.

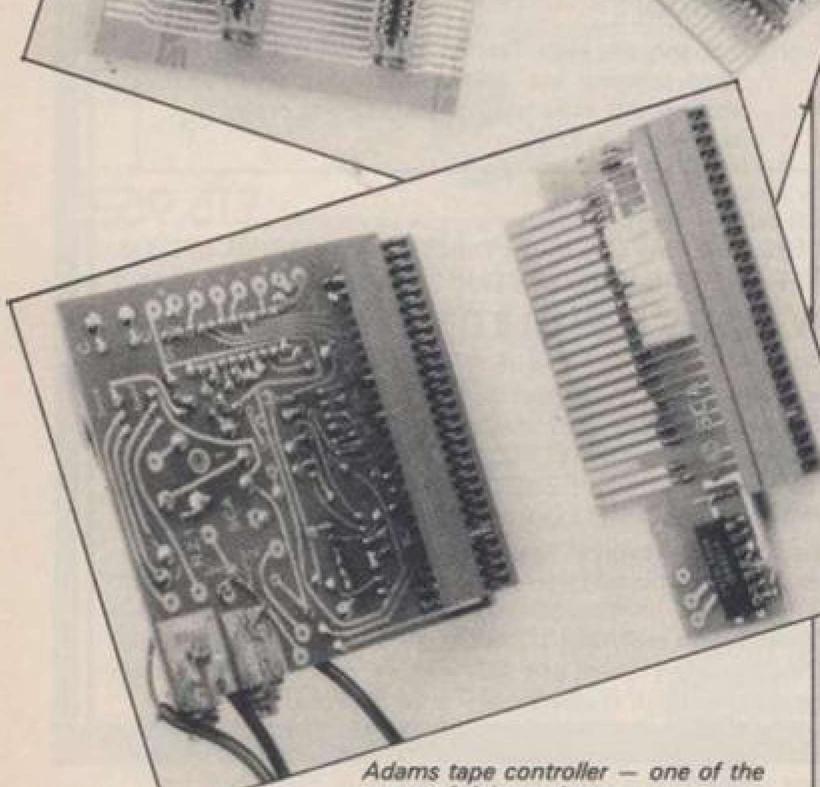
The 24-line PPI has been configured in the Spectrum's I/O map so that it will not clash with the Printer Microdrive or RS-232 interface. The PPI costs £16.50, the stackable connector is £5.50, and the two-slot mother board is £16.95.

Add ZX-81 hardware

There are three Adam adaptors for the Spectrum; each allows you to add ZX-81 hardware on to your machine. The fundamental adaptor provides a ZX-81-compatible output port at the rear of the Spectrum, but no address conversions. The adaptor comes with a computer printout description which tells you how to attach memory-mapped devices which do not decode the lower five address

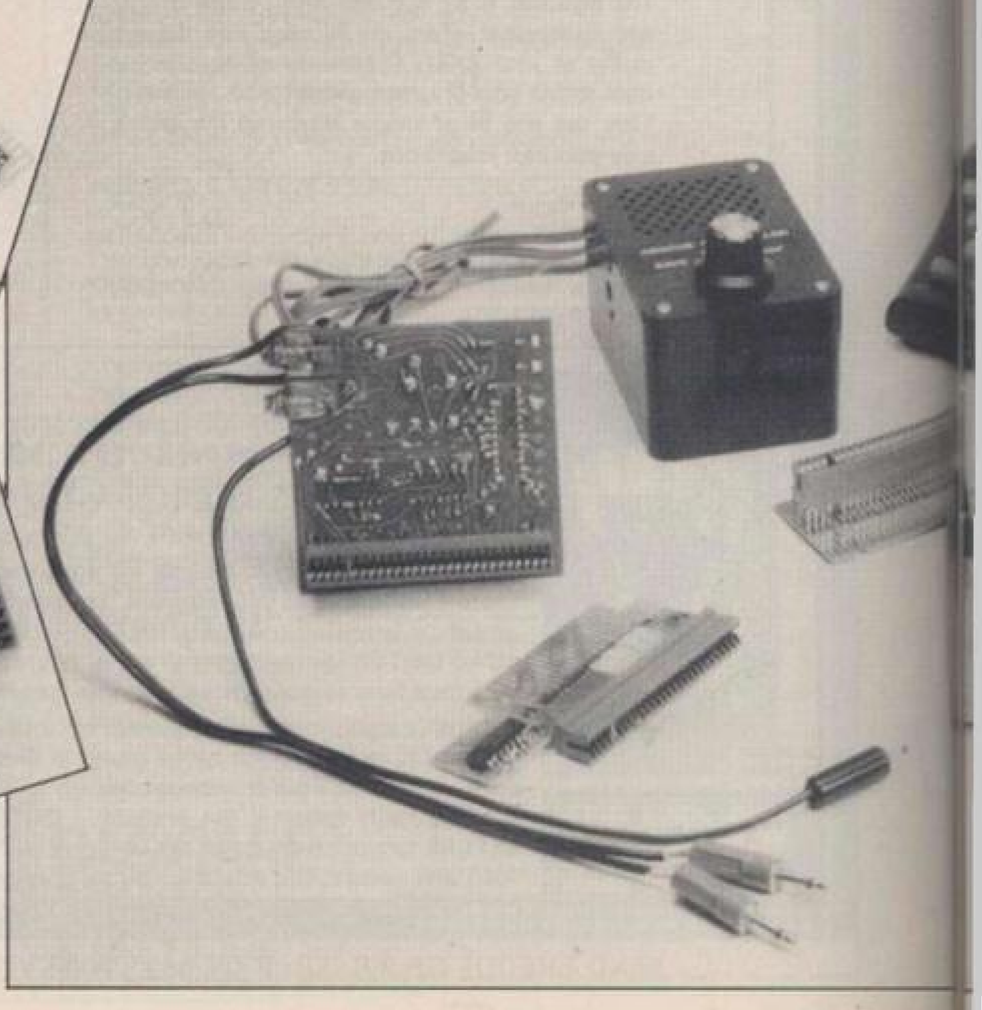
Kempston Electronics motherboard and back-to-back edge-connector.





Adams tape controller — one of the range of Adam adaptors.

SPECTRUM



lines in the I/O map. The next adaptor — the Adam II adaptor — allows the simultaneous use of two sets of peripherals on the rear of a 16K Spectrum. This adaptor allows you to attach a ZX-81 16K RAMpack to a 16K Spectrum.

The Adam II adaptor can interface with any ZX-81 peripheral which was designed to work in the 0 to 16K region of the ZX-81's memory map, by using it in the 48K to 64K region of the Spectrum's map. Thus ZX-81 equipment will require 49152 to be added to its addressing, and for this reason EPROMs designed to work on the ZX-81 will probably not work on the Spectrum.

Finally, there is the more adventurous Eve adaptor, for those with a 48K Spectrum. With a 48K Spectrum all 64K of the address lines on the Z-80A CPU are already accounted for — 16K ROM and 48K RAM — hence adding any device mapped in the RAM area seems impossible; especially as Sinclair did not provide a RAMCS line at the rear which would have allowed us to turn off some, or all, of the internal RAM. By adding this adaptor and making a few soldering connections inside your Spectrum you can turn off 8K of the upper 32K of RAM and map devices into this area. Of course, making the alteration could invalidate your guarantee.

The RZ-1 Tape Controller is another more recent device from Stephen Adams. It provides both Spectrum and ZX-81 owners with a programmable tape control unit for stopping and starting the cassette motor under software control, or disconnecting the load lead when Saving and vice versa. The RZ-1 plugs in via an edgeconnector. The rear connector of the machine is duplicated behind the RZ-1, so a peripheral unit can still be attached. The RZ-1 can control two tape recorders and provide a minimum of five latched outputs for controlling external devices.

Furthermore, it does not use any memory locations, either in RAM or in the I/O map. The unit is located in ROM space between 512 and 1024. Poking various locations in this region allows you to turn on any of the tape motors, or to provide an output to one of the ports.

Upgrade range

East London Robotics provides a range of RAM upgrades for the Spectrum: the SP-48A which adds a further 32K of RAM to the 16K Pectrum Series 1 on a plug-in board; the S048 for the current Series 2 version of the Spectrum and an SP-80 RAM add-on which gives not only 32K of extra memory but another 32K which can be accessed as well, using Out commands. It is thus possible to use a full 80K of user RAM with this board.

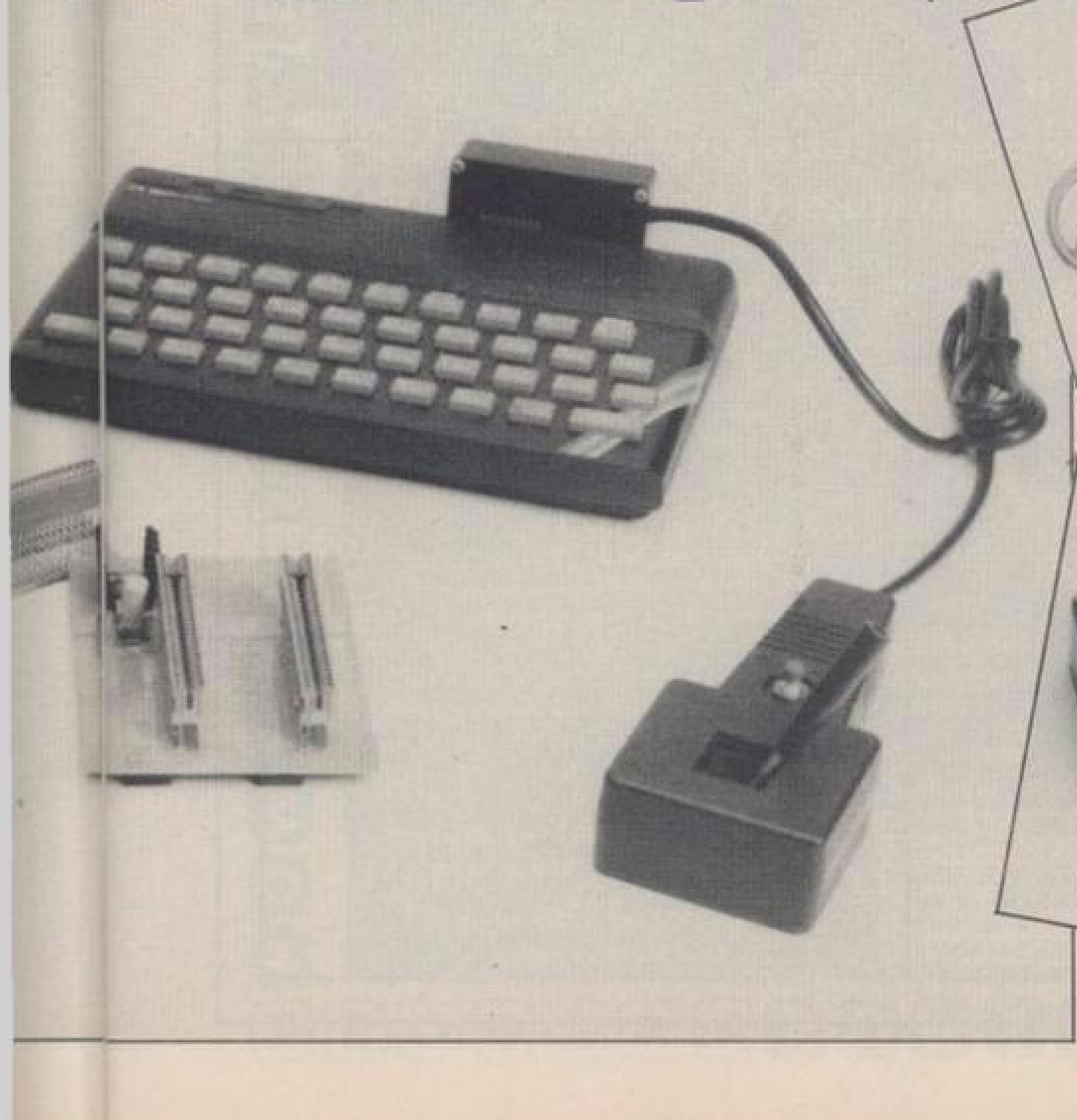
East London Robotics' Slowloader allows you to load ZX-81 programs into a ZX Spectrum.

The Slowloader adapts itself upon loading to whichever type of Spectrum is in use.

CONCLUSIONS

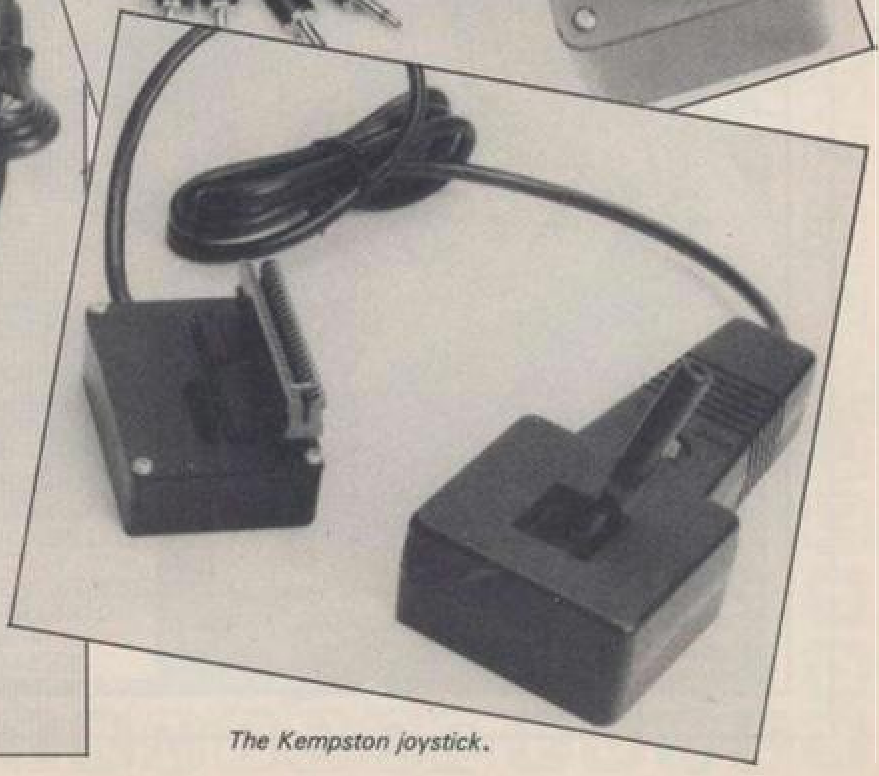
- Perhaps if Sinclair had put a little more thought into primary design, devices like the Abacus controller probably would not be necessary. Its boost to the Spectrum's amplification is useful, as is the capability to switch it off when the keyboard bleeper gets on your nerves.
- Once Kempston's joystick is fitted, nothing else can be added to the connector. But what sort of peripheral would you use in conjunction with a joystick? By putting a stackable connector between the Spectrum and the stick's connector one could test the joystick with the supplied demonstration program.
- The Adam adaptors are extremely useful, but consider whether or not you really want to make hardware alterations.
- The Adams tape controller is effectively transparent to the Spectrum or ZX-81, since it does not use any memory location either in RAM or in the I/O map. The relays involved can cope with 1A at 28V dc or 100V ac. They are sufficiently heavy-duty for many purposes like controlling model train layouts. ■

M ADD-ONS





The Abacus controller includes an amplifier.


The Kempston joystick.

ZX-81 DEE

WITH THE GROWING number of video inverters on the market for the ZX-81, I thought it was about time some games were written for use with one.

"Deep Space" is mostly in Basic with four short machine-code routines to animate the display.

A galactic megatrawler is cruising through the computer-generated universe eating stars. Black holes, white dwarfs, and anti-matter are already in the program but as it is in Basic, you can add your own pet horrors at will.

Attacks by alien craft are frequent, althougfi escape from these is possible by engaging "hyperdrive" to re-materialise in a fresh — and unknown — universe. The game can develop in different ways depending on whether you prefer to stay and fight or run and hide.

It will, of course, run perfectly well on any 16K ZX-81 but the display loses a deal of its visual effect. Hints are given later for a suggested improvement if you wish to try.

Type in Fast mode a Rem statement consisting of 97 characters as line 1, and the machine-code loader as in program 3. Now Run this and Enter the hex code from table 1, one pair at a time. When you reach the end enter S to stop the program, and List it. The last word in line 1 should be Tan. If it is not, then you have made an error and will have to start again.

Now enter Poke 16510,0 as a direct command and line 1 should become line 0. This is to prevent the Rem from being edited. If you attempt to Edit you will loose some of the code as it contains unseen bytes.

Next add the Basic in program 2 to overwrite program 1 and type in as a direct command Poke 16580,201. Run the program in Slow mode to test your machine code.

The screen should fill immediately with stars. Check for a report code. If it is a 5 then your code contains an error in addresses 16514 to 16528. If it prints something else, 16521 is wrong.

Pressing 6 should clear the screen from the bottom up. Stop before it reaches the top of the screen and press 7. The screen should refill downwards. Break the program and Poke 16580,0. Running it again should give you a display which gets narrower as you Scroll up and down. If it does, all is well. A quick press on the 0 key and the screen should invert. If all is working well, delete lines 2 to 8 and enter the main listing, after first saving to tape.

The variables are as follows:

S	High score
A	Shield strength
B	Game score
C and G	Initial numbers of stars and white dwarfs in each line of the display
D and E	Define the position of your ship
P	Top left-hand corner of the screen — all other points on the display are calculated from this
W	Initially a white dwarf, changed under attack to an alien spacecraft
T	Part of the random number multiplier. Reduce this to 1000 to make attacks come faster
F	Your current position on the screen
H	Denotes attacks and black holes
M	Defines the first print position in the line in which the stars need to be reprinted after scrolling
N	Adjust the unprinting position of your ship which will no longer be in line 12 after a scroll

V, X, Y and Z are used to call the various machine-code routines and have no particular significance themselves. V is the title page background X and Y are the scrolls up and down and Z inverts the display file.

Lines 45-70 print the initial universe and line 72 tests to see whether or not it is composed of anti-matter and sends you the "End of game" routine at line 450 if it is. The main loop starts at line 80. If you are altering the game, keep this loop as short as possible or you will slow things down unnecessarily.

Lines 85-87	Check whether a star, dwarf or alien has been encountered and send you the appropriate sub routine.
Line 90	Random-number generator.
Line 110	Steers your spacecraft horizontally.
Lines 120-121	Take you out of the loop to scroll in either direction.
Line 122	Sends you to the subroutine at line 600 to make a hyperspace jump.
Line 130	Returns you to the start of the loop.
Lines 140-153	Print the correct numbers of starts after using the scroll routines at 300 or 400. Both these work in the same way with 300 scrolling down and 400 scrolling up.
Lines 460-470	Restore your shields to full power and increment your score by 10 if you manage to catch an alien.
Line 500	Checks the random number multiplier to see if you are being attacked.
Line 520	Switches to attack mode.
Line 529	Checks for a direct hit.
Line 550	Pokes the alien ships.
Lines 560-570	Adjust and check your shields.
Lines 600-620	Produce the white dwarf crash whilst
Lines 701-708	Make the stars sparkle as they are eaten.

When you have finished entering everything, type in Goto 1000 and Save to tape. The game should auto-start and greet you with the title page.

It looks rather a lot to type, but lines 1000-2029 contain an animated title routine printed in Basic but operated by the machine

Hex code. Table 1 — 97 bytes.

FD	36	22	00	06	C0	
3E	17	D7	D7	D7	D7	
10	FA	C9				
2A	0C	40	54	5D	01	
21	00	00	00	00	09	
01	F7	02	ED	B0	2A	
0C	40	01	17	03	09	
06	20	AF	77	2B	10	
FC	C9					
2A	0C	40	01	F6	02	
09	E5	01	21	00	09	
EB	E1	01	F7	02	ED	
B8	00					
2A	0C	40	06	20	AF	
23	77	10	FC	C9		
06	18	2A	0C	40	23	
7E	FE	76	28	05	C6	
80	77	18	F5	10	F3	C9

Hex code. Table 2 — 96 bytes.

FD	36	22	00	06	C0	
3E	17	D7	D7	D7	D7	
10	FA	C9				
2A	0C	40	54	5D	01	
21	00	09	01	F7	02	
ED	B0	2A	0C	40	01	
17	03	09	06	20	3E	
80	77	2B	10	FC	C9	
2A	0C	40	01	F6	02	
09	E5	01	21	00	09	
EB	E1	01	F7	02	ED	
B8	00					
2A	0C	40	06	20	3E	
80	23	77	10	FC	C9	
06	18	2A	0C	40	23	
7E	FE	76	28	05	C6	
80	77	18	F5	10	F3	C9

Program 2.

```
   0■REM (MACHINE CODE)
   1 RAND USR 16514
   2 IF INKEY$="6" THEN LET X=US
R 16529
   3 IF INKEY$="7" THEN LET Y=US
R 16561
   4 IF INKEY$="0" THEN LET Z=US
R 16592
   5 GOTO 2
```

Main listing.

```
   0■REM CLEAR 06 ▞"""Y±NOT NOT N
OT NOT ( IF TAN E£RND??▘5 E£RND
▘ RUN ▘ GOSUB ■E£RND▘ ±■ ▘4■?F( U
NPLOT TAN E£RND▘ PLOT ▘ FAST ▘5
  FOR LPRINT ▘ RUN ▘ GOSUB ■ E£
RND▞4■7?( UNPLOT TAN ▞/E£RND7■?/
 PRINT ( NEXT TAN
   1 REM "DEEP SPACE" BY A.C.SPR
IDDELL
   9 LET S=0
  10 LET A=0
  11 LET B=0
  12 LET G=1
  13 LET C=2
  14 LET N=12
  15 LET E=15
  16 LET D=15
  25 LET P=PEEK 16396+256*PEEK 1
6397+1
```

code to give the game a more finished appearance — well worth the effort involved.

If you want to alter the initial title page or instruction routine do ensure that you return the machine code to Game Scroll by Poking 16580,0 otherwise you will have columns of stars printed each time you move upwards.

As you play the game you will find that you are much more likely to be attacked in a heavily-populated universe than in a dead one, and that there are universes in which you stand a good chance of catching alien ships and building a high score.

If you do not have a video inverter, the display can be greatly improved by using the machine code from table 2. You will now need only 96 characters in line 1 as the code in table 1 has some NOP bytes which are not used but have been left in for historic reasons.

Add line 41 to the main listing:

```
41 LET Z=USR 16591
```

Note that the addresses called are now as follows:

```
X=16529
Y=16559
Z=16591
```

and lines 1035 and 1075 should read:

POKE 16578,201 and

POKE 16578,0 respectively.

All printing should be inverted including the spaces and all Poked characters must also be inverted by adding 128 to their numbers. The exception to this is 133 in lines 87 and 550 as this is already an inverse character. For example: line 40 which prints white dwarfs now becomes: LET W=155

and in lines 62, 85, 152 and 705 the 23 is changed to 151.

If you are not sure whether or not you have changed all the characters, run the program and press the break key whenever an incorrect one is printed. This will give you the line number which you need to alter.

GAMES



Stars and planets may be standard fare for your megatrawler, but black holes, white dwarfs and anti-matter will give you indigestion on a cosmic scale in Adrian Priddell's ZX-81 game.

EEP SPACE

```
  40 LET W=27
  45 FOR J=0 TO 23
  50 FOR K=1 TO G
  51 POKE P+33*J+INT (RND*30+1),
W
  52 NEXT K
  60 IF C=0 THEN GOTO 70
  61 FOR K=1 TO C
  62 POKE P+33*J+INT (RND*32),23
  63 NEXT K
  70 NEXT J
  71 SLOW
  72 IF C=3 AND G=3 THEN GOTO 45
0
  75 LET T=2000
  80 LET F=(D+P+396)
  85 IF PEEK F=23 THEN GOSUB 700
  86 IF PEEK F=27 THEN GOSUB 600
  87 IF PEEK F=133 THEN GOSUB 46
0
  90 LET H=INT ((RND*T)/(C+1))
  91 IF H=40 THEN GOTO 240
  92 IF H<=5 THEN GOSUB 500
 100 PRINT AT N,E;" ";AT 12,D;"O
"
 101 LET N=12
 105 LET E=D
 110 LET D=D+(INKEY$="8" AND D<3
1)-(INKEY$="5" AND D>0)
 120 IF INKEY$="7" THEN GOTO 300
 121 IF INKEY$="6" THEN GOTO 400
 122 IF INKEY$="H" THEN GOTO 800
 130 GOTO 80
 140 FOR J=1 TO G
 141 POKE P+M+INT (RND*30+1),W
 142 NEXT J
 150 IF C=0 THEN GOTO 80
 151 FOR J=1 TO C
 152 POKE P+M+INT (RND*32),23
 153 NEXT J
 160 GOTO 80
 200 PRINT AT N,D;" ";AT 12,E;"
"
 201 PRINT AT 19,8;"SHIP DESTROY
ED"
 210 PRINT AT 10,9;" END OF GAME
 ";AT 12,10;"REPLAY  Y/N"
 215 IF B>S THEN LET S=B
 220 PRINT AT 21,1;"YOU SCORED "
;B;AT 21,17;"HIGH SCORE=";S
 225 IF INKEY$="Y" THEN GOTO 230
 226 IF INKEY$="N" THEN GOTO 900
 227 GOTO 225
 230 CLS
 231 GOTO 10
 240 RAND USR 16592
 245 RAND USR 16592
 250 IF H=5 THEN GOTO 200
 252 PRINT AT N,D;" ";AT 12,E;"
"
 255 FOR J=1 TO 30
 256 PRINT AT 19,3;" SWALLOWED B
Y BLACK HOLE ";AT 19,3;" SWALLOW
```

(continued on next page)

(continued from previous page)

```
ED BY BLACK HOLE ";AT 0,0;
 260 NEXT J
 270 GOTO 210
 300 LET Y=USR 16561
 301 LET M=0
 302 LET N=13
 310 GOTO 140
 400 LET X=USR 16529
 401 LET M=759
 402 LET N=11
 410 GOTO 140
 450 LET Z=USR 16592
 451 PRINT AT 6,5;" YOU HAVE ENT
ERED AN ";AT 7,5;" ANTIMATTER UN
IVERSE "
 452 GOTO 201
 460 LET A=0
 470 LET B=B+10
 480 RETURN
 500 IF T=100 THEN GOTO 530
 510 FOR J=1 TO 25
 511 PRINT AT 21,5;"ALIEN SHIPS
NEARBY"
 512 NEXT J
 513 PRINT AT 21,5;"
    "
 520 LET T=100
 529 IF H<>5 THEN RETURN
 530 FOR J=1 TO 12
 531 PRINT AT 21,4;" YOU ARE UND
ER ATTACK ";AT 21,4;" YOU ARE UN
DER ATTACK ";AT 0,0;
 532 NEXT J
 540 PRINT AT 21,4;"
    "
 550 LET W=133
 560 LET A=A+1
 570 IF A>=3 THEN GOTO 640
 580 RETURN
 600 FOR J=1 TO 5
 601 POKE F-33,128
 602 POKE F-1,128
 603 POKE F,128
 604 POKE F+1,128
 605 POKE F+33,128
 606 POKE F-33,0
 607 POKE F-1,0
 608 POKE F,52
 609 POKE F+1,0
 610 POKE F+33,0
 620 NEXT J
 630 LET A=A+1
 640 IF A>=4 THEN GOTO 200
 650 FOR J=1 TO 20
 655 IF A=1 THEN PRINT AT 21,1;"
COLLISION WITH WHITE DWARF"
 660 IF A=2 THEN PRINT AT 21,1;"
SHIELDS DOWN TO HALF POWER"
 665 IF A=3 THEN PRINT AT 21,1;"
SHIELDS COMPLETELY EXHAUSTED"
 670 NEXT J
 680 PRINT AT 21,1;"

 690 RETURN
 700 PRINT AT N,E;" "
 701 POKE F,52
 702 FOR J=1 TO 3
 703 POKE F,61
 704 POKE F,21
 705 POKE F,23
 706 NEXT J
 707 POKE F,151
 708 POKE F,52
 710 LET B=B+1
 720 RETURN
 800 LET C=INT (RND*4)
 801 LET G=INT (RND*3)+1
 810 FAST
 815 CLS
 820 GOTO 40
 900 CLS
 910 RAND USR 16514
 915 FOR J=1 TO 50
 920 PRINT AT 12,5;" OK THANKS F
OR PLAYING "
 925 NEXT J
 930 NEW
1000 CLS
1010 SAVE "DEEP SPACE"
1020 LET V=USR 16514
1030 PRINT AT 8,5;" *** DEEP SP
ACE *** ";AT 12,1;"PLEASE SWITCH
 TO INVERSE VIDEO";AT 12,1;"PLEA
SE SWITCH TO INVERSE VIDEO";AT 2
2,3;"FOR INSTRUCTIONS PRESS ""0"
"";AT 20,3;"TO PLAY PRESS ""1"""
1035 POKE 16580,201
1040 IF INKEY$="0" THEN GOTO 200
0
1050 IF INKEY$="1" THEN GOTO 107
0
1060 GOTO 1030
1070 PRINT AT 0,0;"*** DEEP SPAC
E ** DEEP SPACE ***"
1072 FOR J=1 TO 24
1073 LET Y=USR 16561
1074 NEXT J
1075 POKE 16580,0
1076 FOR J=1 TO 24
1077 LET Y=USR 16561
1078 NEXT J
1080 RUN
2000 PRINT AT 1,1;"

2001 PRINT "* YOU ARE THE CAPTAI
N OF A       ** SPACE TRAWLER ROAM
ING THE      ** UNIVERSE IN SEARCH
 OF STARS.   *"
2002 PRINT "*
             *"
2003 PRINT "* BEWARE OF WHITE DW
ARFS. THEY   ** WILL DAMAGE YOUR S
HIELDS AND   ** LEAVE YOU DEFENCEL
ESS AFTER    ** THREE COLLISIONS.
YOUR SHIP    ** MAY THEN BE DESTRO
YED BY AN    ** ATTACK FROM HOSTIL
E SHIPS      *"
2004 PRINT "*
             *"
2005 PRINT "* YOU ARE UNARMED AN
D CANNOT     ** OUTRUN THEM.YOUR O
NLY ESCAPE   ** IS TO MAKE A HYPER
SPACE JUMP   ** INTO THE NEW PERIL
S OF AN      ** UNKNOWN UNIVERSE.
             *"
2006 PRINT "*
             *"
2007 PRINT "*
             *"
2008 PRINT "* PRESS 0 FOR MORE I
NFORMATION   *"
2009 PRINT "*
             *"
2010 PRINT "*
             *"
2011 IF INKEY$<>"0" THEN GOTO 20
11
2012 FOR J=1 TO 24
2013 LET Y=USR 16561
2014 NEXT J
2015 PRINT AT 1,0;"*
                *"
2016 PRINT "*         SCORING AND
MOVING       *"
2017 PRINT "*
             *"
2018 PRINT "* ONE POINT IS GAINE
D FOR EACH   ** STAR CRUSHED
             *"
2019 PRINT "*
             *"
2020 PRINT "* TEN POINTS ARE SCO
RED FOR AN   ** ALIEN SHIP CRUSHED
             *"
2021 PRINT "*
             *"
2022 PRINT "*          BUT BEWARE.
...          *"
2023 PRINT "*
             *"
2024 PRINT "* YOU CAN ONLY WITHS
TAND THREE   ** ATTACKS BEFORE YOU
R SHIP IS    ** DEFENCELESS ALTHOU
GH YOU CAN   ** RESTORE YOUR SHIEL
DS TO FULL   ** POWER IF YOU MANAG
E TO CATCH   ** AN ALIEN SPACECRAF
T.           *"
2025 PRINT "*
             *"
2026 PRINT "* USE CURSOR KEYS TO
 MOVE AND    ** H FOR A HYPERSPA
CE JUMP.     ** WHEN YOU ARE READY
 PRESS 1     *"
2027 PRINT "*
             *"
2028 IF INKEY$<>"1" THEN GOTO 20
28
2029 GOTO 1075
```

Program 3.

```
   1 REM (97 CHARACTERS)
   2 LET X=16514
   3 INPUT A$
   4 IF A$="S" THEN STOP
   5 PRINT A$;"-";
   6 POKE X,16*CODE A$+CODE A$(2
)-476
   7 LET X=X+1
   8 GOTO 3
```

■

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```
1 REM***MINOTAUR***
3 REM***R.MIAH (C)1982***
10 FORA=0TO1024
20 POKE6144+A,PEEK(32768+A)
30 NEXT
40 FORA=0TO581
50 READD
60 POKE6144+A,D
70 NEXT:POKE36869,254
100 DATA0,0,0,0,0,0,1,14
110 DATA0,0,0,0,0,0,192,32
120 DATA0,0,0,0,0,0,0,3
130 DATA0,0,0,0,0,0,0,64
140 DATA0,0,1,2,4,8,16,32
150 DATA0,128,96,16,8,4,194,161
160 DATA16,32,35,66,132,68,34,17
170 DATA24,6,129,64,32,16,8,4
180 DATA0,0,224,16,8,4,3,65
190 DATA0,8,4,2,1,7,31,191
200 DATA20,41,226,252,255,255,255,255
210 DATA16,8,135,127,255,255,255,255
220 DATA4,8,85,250,252,248,241,226
230 DATA64,137,18,36,72,144,32,64
240 DATA144,8,8,8,8,8,112,129
250 DATA128,128,128,128,128,128,128,0
260 DATA12,3,0,0,0,0,0,0
270 DATA131,128,0,0,0,0,0,7
280 DATA160,80,40,20,122,93,143,215
290 DATA255,127,63,31,15,3,159,106
300 DATA255,255,255,255,255,255,255,253
310 DATA255,255,255,255,255,255,255,107
320 DATA132,105,82,111,79,31,255,255
330 DATA129,2,1,128,64,32,0,192
340 DATA2,14,240,0,0,0,0,0
350 DATA0,1,0,0,0,0,0,0
360 DATA8,240,128,185,112,9,6,0
370 DATA32,24,4,11,4,197,36,126
380 DATA10,18,226,0,0,128,64,32
390 DATA220,132,4,22,33,32,16,8
400 DATA171,8,8,8,0,0,0,0
410 DATA252,224,192,64,0,8,100,130
420 DATA96,32,16,8,4,4,5,2
430 DATA0,0,0,0,0,0,0,192
440 DATA188,252,62,249,153,153,173,49
450 DATA31,17,8,36,19,72,39,16
460 DATA8,136,105,115,141,0,0,0
470 DATA31,98,132,136,114,5,122,2
480 DATA3,2,131,131,131,6,9,9
490 DATA0,128,128,64,33,18,12,0
500 DATA32,16,16,240,16,0,0,0
510 DATA17,16,16,16,16,8,4,12
520 DATA0,0,0,0,0,7,8,18
530 DATA0,126,129,0,255,0,0,0
540 DATA0,0,0,0,0,224,16,72
550 DATA9,9,10,2,1,1,1,3
560 DATA14,11,11,11,9,9,9,9
570 DATA39,39,229,228,226,224,240,248
580 DATA0,128,129,129,66,36,60,0
590 DATA196,228,228,36,69,15,31,63
600 DATA4,56,112,144,144,144,16,16
610 DATA9,9,9,9,8,8,8,4
620 DATA252,251,249,253,255,255,127,255
630 DATA0,255,36,36,165,247,255,255
640 DATA127,191,190,254,254,254,254,252
650 DATA16,16,16,16,16,16,32,32
660 DATA4,2,1,0,0,0,0,0
670 DATA126,124,56,146,147,82,78,34
680 DATA103,1,0,204,51,35,51,115
690 DATA248,240,96,161,97,97,194,4
700 DATA32,64,128,0,0,0,0,0
710 DATA33,16,8,4,3,0,0,0
720 DATA254,124,0,0,0,255,0,0
730 DATA8,16,32,64,64,128,0,0
740 DATA0,0,0,0,0,0,0,0
750 DATA0,0,0,171,168,232,168,168
760 DATA0,0,0,227,132,135,132,132
770 DATA0,0,0,17,149,153,153,149
780 DATA0,0,0,234,10,196,4,228
790 DATA201,169,198,198,166,198,0,0
800 DATA193,161,161,193,161,169,0,0
810 DATA20,181,85,21,21,21,0,0
820 DATA201,41,47,233,41,41,0,0
1000 PRINT"ℑ"
1001 FORX=0TO505:POKE7680+X,64:NEXT:
1010 PRINT"▓▓▓▓▓▓▶▶▶▶▶▶▶@A——BCDE-
1020 PRINT"▶▶▶▶▶▶FGHIJKLMNO-
1030 PRINT"▶▶▶▶▶▶PQRSTUVWX-
```

MINOT

MINOTAUR IS for a Vic with a 3K expansion. Each time the program runs it draws a different maze. The player's task is to move from start to finish in the shortest possible time, using the B, N, H and space keys to direct a light square left, right, up and down — respectively.

Before setting up the maze, the program displays the Minotaur in what might be called an opening-page sequence. By making extensive use of user-defined characters a rather startling display is achieved which pushes the Vic graphics to the limit.

However, strictly speaking, this display is not essential to the rest of the program and accounts for nearly half the program's length. Anyone who wishes to forgo this graphic treat can save themselves a lot of keying in. To do this leave out lines 40 to 2050; keep line 70 but remove the Next at the beginning.

When you run the program nothing appears on the screen for about 45 seconds. It takes this amount of time to set up the high-res graphics.

Vic owners with 16K or 8K expansion packs might like to try their hands at converting Minotaur to the different memory configuration. One solution to this problem would be to move the start of Basic to 7168 and load the new character set to 5120. They will need to type in Poke 7168,0: Poke 44,28 before loading to move Basic, and Poke 36869,205 to relocate the character definitions at 5120.

All references in the program to the screen and colour memory maps, as well as the start of the character set, will also need to be changed.



TAUR

In escaping the Minotaur, the least of Theseus's worries was how he was doing against the clock — that's your problem in Roger Miah's game for the Vic.



```
1040 PRINT"▶▶▶▶▶▶YZ[\]↑← !-
1050 PRINT"▶▶▶▶▶▶━━#$%&'(-
1060 PRINT"▶▶▶▶▶▶━)*+,--
1070 PRINT"▶▶▶▶▶▶━./012-
1080 PRINT"▶▶▶▶▶▶━34567-
1090 PRINT"▶▶▶▶▶▶━89:;<-
2000 PRINT"▶▶▶▶▶▶━━=>?-
2001 PRINT"▼▼▼▶▶▶▶▶▶▶▶▶▶|━"
2002 PRINT"TTTTTTTTTTTTTTTTTTTT▶▶▶▶▶▶▶▶┌▶┤ |"
2010 POKE7908,34
2020 FORX=24TO31
2030 POKE36879,X
2040 FORT=1TO500:NEXTT,X
2050 GETA$:IFA$=""THEN2020
2060 POKE36869,240
2070 PRINTCHR$(142)"■■";
2080 POKE36879,25
2090 INPUT"INSTRUCTIONS";A$:IFLEFT$(A$+"Y",1)<>"N"THENGOSUB2690
2100 POKE36879,93
2110 PRINT"■"
2120 XM=22:YM=21
2130 DIMMZ%(XM,YM),U%(3)
2140 FORL=38400TO38905:POKEL,7:NEXTL
2150 FORL=1TO20:MZ%(0,L)=10:MZ%(XM,L)=10:NEXTL
2160 FORL=1TO21:MZ%(L,0)=5:MZ%(L,YM)=5:NEXTL
2170 MZ%(0,0)=15:MZ%(0,YM)=15:MZ%(XM,0)=15:MZ%(XM,YM)=15
2180 X=10:Y=10
2190 A=0
2200 IFMZ%(X-1,Y)=0THENU%(A)=1:A=A+1
2210 IFMZ%(X,Y-1)=0THENU%(A)=4:A=A+1
2220 IFMZ%(X,Y+1)=0THENU%(A)=2:A=A+1
2230 IFMZ%(X+1,Y)=0THENU%(A)=3:A=A+1
2240 IFA=0ANDX=10ANDY=10THEN2410
2250 IFA=0THENR=INT(MZ%(X,Y)/256):GOTO2340
2260 B=INT(RND(1)*(A+1)):IFB>=ATHEN2260
2270 R=U%(B)
2280 IFR=1THENMZ%(X,Y)=(MZ%(X,Y)OR1):MZ%(X-1,Y)=(3*256OR4)
2290 IFR=2THENMZ%(X,Y)=(MZ%(X,Y)OR2):MZ%(X,Y+1)=(4*256OR8)
2300 IFR=3THENMZ%(X,Y)=(MZ%(X,Y)OR4):MZ%(X+1,Y)=(256OR1)
2310 IFR=4THENMZ%(X,Y)=(MZ%(X,Y)OR8):MZ%(X,Y-1)=(2*256OR2)
2320 GOSUB2800
2330 POKE38400+22*X+Y,7
2340 IFR=1THENX=X-1
2350 IFR=2THENY=Y+1
2360 IFR=3THENX=X+1
2370 IFR=4THENY=Y-1
2380 GOSUB2800
2390 POKE38400+22*X+Y,2
2400 GOTO2190
2410 X=1:Y=1:MZ%(1,1)=MZ%(1,1)OR8:GOSUB2800
2420 X=1:Y=0:MZ%(1,0)=2:GOSUB2800
2430 X=1:Y=0:MZ%(1,0)=2:GOSUB2800
2440 X=21:Y=20:MZ%(21,20)=MZ%(21,20)OR2:GOSUB2800
2450 X=21:Y=21:MZ%(21,21)=8:GOSUB2800
2460 X=1:Y=0
2470 TI$="000000"
2480 GETA$
2490 PRINT"■■■"INT(TI/6)/10
2500 POKE38400+22*X+Y,4
2510 IFA$="H"AND(MZ%(X,Y)AND1)<>0THENX=X-1
2520 IFA$="B"AND(MZ%(X,Y)AND8)<>0THENY=Y-1
2530 IFA$="N"AND(MZ%(X,Y)AND2)<>0THENY=Y+1
2540 IFA$=" "AND(MZ%(X,Y)AND4)<>0THENX=X+1
2550 POKE38400+22*X+Y,3
2560 IFX<>22ANDY<>21THEN2480
2570 RESTORE
2580 POKE36878,15
2585 FORL=1TO20
2590 FORM=220TO160STEP-4
2595 POKE36876,M
2600 NEXTM
2610 FORM=160TO220STEP4
2615 POKE36876,M
2620 NEXTM
2630 NEXTL
2640 POKE36878,0
2650 POKE36876,0
2660 PRINT"■■▶▶▶▶▶▶▶PRESS <RETURN>";
2670 GETA$:IFA$<>CHR$(13)THEN2670
2680 RUN
2690 PRINT"■■******MINOTAUR******■"
2700 PRINT"▲THIS PROGRAM DRAWS A    MAZE."
2710 PRINT"▼YOU'RE TO MOVE ACROSS IT IN THE SHORTEST      POSSIBLE TIME."
2720 PRINT"▼WHEN THE MAZE IS READY(TOTALLY RED)YOU GUIDE THE LITTLE LIGHT";
2730 PRINT"        SQUARE WITH: ■H■"
2740 PRINT"                ■B■ ■N■"
2750 PRINT"              ■<SPACE>■"
2760 PRINT"▼▲THE START IS IN UPPER LEFT CORNER.THE FINISHIN THE LOWER RIGHT ONE
"
2770 PRINT"■■■PRESS***RETURN***■"
2780 GETA$:IFA$<>CHR$(13)THEN2780
2790 RETURN
2800 IF((MZ%(X,Y)AND1)<>0)AND((MZ%(X,Y)AND8)<>0)THENP=32+128:GOTO2840
2810 IF((MZ%(X,Y)AND1)<>0)THENP=101+128:GOTO2840
2820 IF((MZ%(X,Y)AND8)<>0)THENP=99+128:GOTO2840
2830 P=79+128
2840 POKE7680+22*X+Y,P
2850 RETURN
2860 DATA187,4,187,4,201,2,201,4,201,2,195,2,195,2,183,2,163,2,175,6,163,1,175,
1
2870 DATA183,2,195,2,195,2,201,2,195,2,183,2,163,3,175,1,183,2,183,2,175,2,175,
2,163,6
```

FORTH BASIC

Will assemblers become a thing of the past? Ian Maclean thinks so and helps to hasten the day by showing you how to hit the stack.

ALL OF A sudden Forth seems to have taken off in a big way; not only have we seen the arrival of the Jupiter Ace — the first-ever Forth home computer but the ZX-81, Atom, BBC and Vic can all now use Forth, making it the second most popular high-level micro language. Speed is a major element in its appeal, and its speed is due to the fact that Forth is a compiled language, that is, the high-level words are translated into a pseudo-machine code and then run in this form giving up to 90 per cent of the speed of machine code. Could assemblers soon become a thing of the past? I think the answer is undoubtedly yes, within the next five or ten years.

A good Forth analogy is given by the balls they put into plastic pipes in bingo. The number is put on to the top and can only be taken from the top of the pile. A stack is a pile of numbers worked on a last-in, first-out system. In Forth, the reserved words Do, If, Int, take their arguments from the stack; a simple Basic-Forth example:

```
BEEP 50, 100        100 50 BEEP
```

Although Beep is not standard Basic or Forth, it demonstrates the principle admirably. The Basic word Beep is interpreted during Running, the interpreter comes across the word Beep and commences to look for the two numbers and the comma which it requires to function. In the meantime, the Forth compiler has put the two numbers on the stack and already executed the word Beep.

Before I proceed with the comparisons there is one further idea which the Basic user has to come to terms with, and that is that there is no actual program. Each sub-program is defined and given a name by which it can be called and executed, for example, a routine called Part 1 would have the following structure:

```
: PART 1
(ROUTINE);
```

Note the space between the colon — which signified a word definition — and the name. Also notice that the word is terminated with a semi-colon. On then to the Forth words which you can put in your word definitions.

Let: The Basic word Let is used in assigning a value to a variable. In Forth there are no pre-defined variables, so before you can define a word using a variable, you have to define it. To set up variable A, for example, with an initial value of zero we type:

```
0 VARIABLE A
```

Now the computer knows what you are talking about when you refer to A. To put a number in a variable, A again, we type:

```
n A !
```

where n is the number to be put in A. To recall the value from A back on to the stack we use

```
A @
```

This may seem strange at first, but so did Basic when I first started programming.

Goto: This word does not exist in Forth, nor does it have any direct equivalent. The nearest thing to it is **Gosub** — this is easy. To call a routine, the routine is first defined as a word, then the word is simply incorporated as with any other Forth word. So in this way a program may be initially written as several subroutines and end up defined by a single word and Run as such.

For-Next: These words are replaced in Forth by Do and Loop or +Loop. The limit and initial value of the loop are put on to the stack first, before the word Do:

```
10 0 DO
```

This is the same as

```
FOR variable=0 TO 10
```

At the end of a loop we can replace the Basic word next with either Loop or +Loop. Loop means "Jump back to Do and add 1 to the loop counter". +Loop means "jump back to Do and add the value on the stack to the loop counter". In other words, +Loop is used for step values other than 1 and is added at the end of a loop like so:

```
2+LOOP
```

This means "step 2" although other values could be used instead of two.

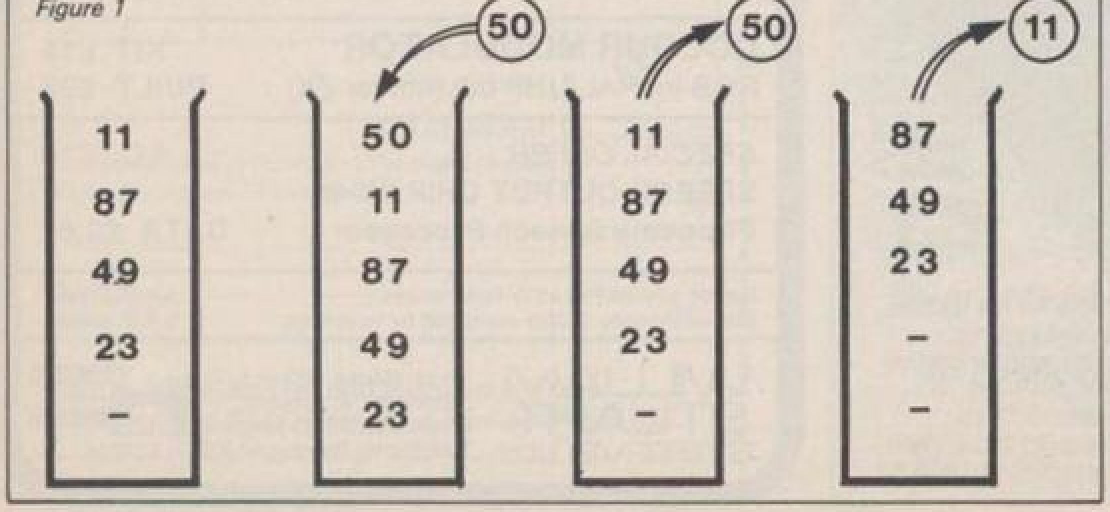
Our loop now looks like this:

```
(limit) (initial value)
(routine)
(step value) +LOOP
```

In Forth, there are several kinds of loop, a further two, in fact. These are conditional loops; Begin — Until and Begin While. These two types are quite simple, but come in very handy.

Firstly, Begin-Until; this is a conditional loop which will repeat the routine it encloses until a positive value is left on the top of the stack before Until. Since we know how to read variables, we can control a Begin-Until loop with one, A, for example:

Figure 1






```
BEGIN
(routine)
A @ UNTIL
```

The same applies to the Begin-While loop which will repeat the loop While the value before While is positive. Again, if the variable A is controlling the loop, it would look like this:

```
BEGIN
(routine)
A @ WHILE
```

Rem: A remark in Forth is very simple, the comment being closed within brackets:

```
(THIS IS A COMMENT)
```

Be careful here, Forth has no mathematical parentheses, so if you attempt anything along those lines you will end up with a jumbled comment.

Input: Forth's equivalent of Basic's Input is Query, which opens up the input buffer for a numerical value to be entered.

Forth also has another kind of input statement, though: Line, which will take an alphanumeric input from the buffer and execute it as a "program" line, before returning back to the main flow. I use it at the end of games, for example, one called Game:

```
: GAME
(main program)
LINE ;
: YES GAME ;
: NO ;
```

In this example Line allows the user to call a word; in this case it would follow the prompt "play again". By typing Yes the user calls the word Yes which in turn executes Game again. If he types No then he executes the word No which Quits the program and hands the

H FOR
C USERS



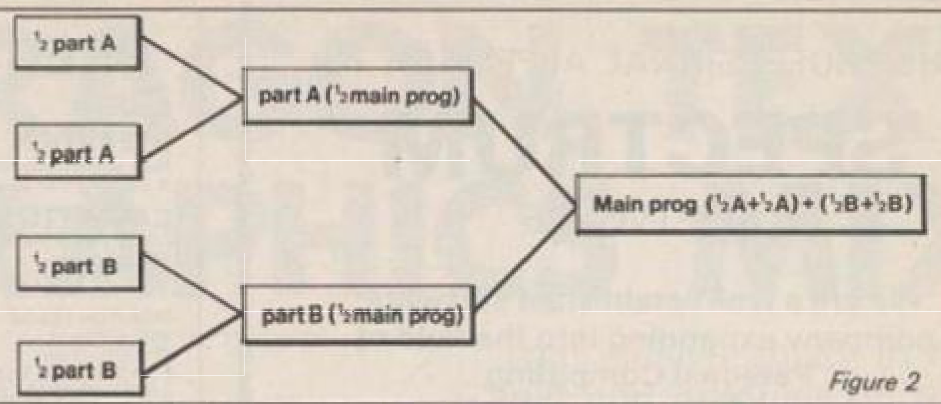


Figure 2

Listing 1

Stack	**Definition**
: NUMBERS	Program name — type this word to run program
." ENTER ANY NUMBER"	Prompt
QUERY	Inputs value
." TYPE :" CR ." SQUARE TO SQUARE THE NUMBER" CR ." CUBE TO CUBE THE NUMBER" CR ." OR" CR ." PATTERN TO MAKE THE NUMBER INTO A PATTERN"	
LINE	Allows Forth word to be called
;	End of numbers word definition
: SQUARE	Program name
DUP	Duplicates number on top of the stack
*	Multiples the two numbers on the top and second stack positions
.	Outputs the number on top of the stack
;	End of Square Word definition
: CUBE	Program name
DUP * SQUARE	Squares number and calls 'square' to square it again and print it out
;	End of cube word definition
: PATTERN	Program name
10 0 DO	Starts loop from 0 to 10
DUP	
I	I retrieves the loop counter value
SPACES	Outputs 'I' number of spaces
.CR	
LOOP	Increments loop counter and jumps to 'DO' if not 10
0 10 DO	Starts loop from 10 to 0
DUP I SPACES . CR	
0 1−	Takes 1 from 0. Puts −1 on stack
+LOOP	Adds −1 to loop counter; decrements loop counter by 1
	End of pattern word definition

Machine	Company	Price	Where obtainable
ZX-81	QCP	£10	11c, Hercies Road, Uxbridge, Middlesex
ZX-81	Artic	£29.95	396 James Reckitt Avenue, Hull, North Humberside HU8 0JA
Atari	Maplin	£49.95	P.O. Box 3, Rayleigh, Essex
Vic	Adda	£38.95	Adda: high street stockists or 154 Victoria Road, London W3
Atom	Acornsoft	£17.50 (with manual)	4A Market Hill, Cambridge CB2 3NJ
BBC	Level 9	£15	229 Hughden Road, High Wycombe, Buckinghamshire HP13 5PG
Dragon 32	Microtanic	£24.95	235 Friern Road, Dulwich, London

keyboard back for programming.

Print: Forth has two very different words for printing characters. Firstly, there is ." which is the equivalent of Print and is used in much the same way:

```
." HELLO"
```

is the same as

```
PRINT "HELLO";
```

Note the space between." and the first character of the string. To get on to the next line we use a carriage return CR, thus:

```
." HELLO" CR
```

is the same as

```
PRINT "HELLO"
```

In some cases it is only necessary to print out one character, here we use Emit. Emit will print out after the last print position the ASCII character whose value is on the stack. For example:

```
65 EMIT
```

prints an 'A'. To Emit a space we can use a special word called

```
SPACE
```

Further to this, to emit several spaces Forth contains a word called Spaces, which takes the number of spaces to be emitted from the top of the stack. So, to emit ten spaces we type:

```
10 SPACES
```

If-Then If-Then in Forth is the same in theory as Basic's version, but is somewhat 'jumbled'. As a rough guide:

```
IF A=0 THEN
```

and

```
A@ 0=IF
(routine)
THEN
```

These are the same. This can be repeated with 0> and 0<. The word If in Forth is considerably different from Basic's version as it will execute the routine if it finds a positive value on the stack. This positive value is usually 1 or 0 as this is what 0=, 0< and 0> produce:

0= puts a 1 on the stack if the value formerly on the stack is zero.

0< puts a 1 on the stack if the value formerly on the stack is negative.

0> puts a 1 on the stack if the value formerly on the stack is positive.

The word Else can also be used so:

```
IF
(routine executed if
stack value is positive)
ELSE
(routine executed if
stack value zero or less)
THEN
```

Finally, a program — listing 1 — written to demonstrate some of the terms briefly covered in this article. Don't be put off by its apparent complexity as all of the words used have been explained. ■

THAT DRAGON TEXT AND GRAPHICS MIX

```
10 GOTO800
14 REM MODE A CURSOR
15 A$=INKEY$:IFA$=""THENDRAW"XCC$;R1;XCA$;L1":GOTO15:ELSEGOTO200
24 REM DRAW TEXT
25 DRAW"C"+CB$+"A"+D$+"S"+STR$(S):ON(ASC(C$)-32)GOSUB33,34,35,36,37,
   38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,
   60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,
   82,83,84,85,86,87,88,89,90:RETURN
32 REM TEXT DATA
33 REM USER-DEFINABLE="!":RETURN
34 DRAW"BM+0,-6DBM+2,+0UBM+4,+6":RETURN
35 DRAW"BM-7,-7E3BM+4,+10":RETURN
36 DRAW"BM-4,-7H3BM+7,+10":RETURN
37 DRAW"BM-8,-7E2F2BM+4,+7":RETURN
38 DRAW"BM-6,+1DGBM+7,-3":RETURN
39 DRAW"BM+0,-6DBM+4,+5":RETURN
40 DRAW"BM+2,+0HU4EBM+4,+6":RETURN
41 DRAW"BM+1,+0EU4HBM+5,+6":RETURN
42 DRAW"BM+0,-1E4BM+0,+4H4BM+8,+5":RETURN
43 DRAW"BM+0,-3R4L2U2D4BM+5,+1":RETURN
44 DRAW"BM-1,+0DGBM+4,-2":RETURN
45 DRAW"BM+0,-3R4BM+4,+3":RETURN
46 DRAW"BM-1,+0UBM+4,+1":RETURN
47 DRAW"BM+0,-1E4BM+4,+5":RETURN
48 DRAW"BM+0,-1FR2EU4HL2GD4BM+8,+1":RETURN
49 DRAW"BM+1,+0U6GBM+6,+5":RETURN
50 DRAW"BM+4,+0L4UER2EU2HL2GBM+8,+5":RETURN
51 DRAW"BM+0,-1FR2EUHL2R2EUHL2GBM+8,+5":RETURN
52 DRAW"BM+3,+0U6G3R4BM+4,+3":RETURN
53 DRAW"BM+0,-1FR2EU2HL3U2R4BM+4,+6":RETURN
54 DRAW"BM+0,-2ER2FDGL2HU4ER2FBM+4,+5":RETURN
55 DRAW"BM+2,+0U2E2U2L4BM+8,+6":RETURN
56 DRAW"BM+1,+0R2EUHL2HUER2FDGL2GDFBM+7,+0":RETURN
57 DRAW"BM+0,-1FR2EU4HL2GDFR3BM+4,+3":RETURN
58 DRAW"BM+0,-5DBM+0,+2DBM+4,+1":RETURN
59 DRAW"BM+0,-5DBM+0,+2DGBM+5,+0":RETURN
60 RETURN
61 DRAW"BM+0,-2R4BM+0,-2L4BM+8,+4":RETURN
62 RETURN
63 DRAW"BM+2,+0UBM+0,-1UREUHLGBM+7,+5":RETURN
64 REM
65 DRAW"U5ER2FD5U3L4BM+8,+3":RETURN
66 DRAW"U6R3FDGFDGL3U3R3BM+5,+3":RETURN
67 DRAW"BM+1,+0HU4ER2FHL2GD4FR2EBM+4,+1":RETURN
68 DRAW"U6R3FD4GL3BM+8,+0":RETURN
69 DRAW"R4L4U3R4L4U3R4BM+4,+6":RETURN
70 DRAW"U3R4L4U3R4BM+4,+6":RETURN
71 DRAW"BM+1,+0R2EULRDGL2HU4ER2FBM+4,+5":RETURN
72 DRAW"U6D3R4U3D6BM+4,+0":RETURN
73 DRAW"BM+1,+0R2LU6LR2BM+4,+6":RETURN
74 DRAW"BM+0,-1FR2EU5BM+4,+6":RETURN
75 DRAW"U6BM+0,+3RE3G3F3BM+4,+0":RETURN
76 DRAW"R4L4U6BM+8,+6":RETURN
77 DRAW"U6F2E2D6BM+4,+0":RETURN
78 DRAW"U6DF4DU6BM+4,+6":RETURN
79 DRAW"BM+1,+0R2EU4HL2GD4FBM+7,+0":RETURN
80 DRAW"U6R3FDGL3BM+8,+3":RETURN
81 DRAW"BM+1,+0R2EU4HL2GD4FBM+1,-2F2BM+4,+0":RETURN
82 DRAW"U6R3FDGL3RF3BM+4,+0":RETURN
83 DRAW"BM+0,-1FR2EH4ER2FBM+4,+5":RETURN
84 DRAW"BM+2,+0U6L2R4BM+4,+6":RETURN
85 DRAW"BM+0,-6D5FR2EU5BM+4,+6":RETURN
86 DRAW"BM+0,-6D4F2E2U4BM+4,+6":RETURN
87 DRAW"BM+0,-6D6E2F2U6BM+4,+6":RETURN
88 DRAW"UE4UBM+0,+6UH4UBM+8,+6":RETURN
89 DRAW"BM+2,+0U4H2F2E2BM+4,+6":RETURN
90 DRAW"R4L4UE4UL4BM+8,+6":RETURN
199 REM CHECK VALID KEY:IF INVALID SOUND RASPBERRY
200 IFINSTR(1,B$,A$)=0THENSOUND2,5:GOTO15
209 REM IF KEY @ THEN GOTO MODE B
210 A=ASC(A$):IFA=64THEN300
219 REM IF KEY S THEN INCREASE SCALE
220 IFA=83ANDS<45THENS=S+4:GOTO290
229 REM IF KEY X THEN RESET SCALE TO DEFAULT
230 IFA=88THENS=4:GOTO290
239 REM IF KEY C THEN PCLS SUBROUTINE
240 IFA=67THEN500
```

(listing continued on page 73)

That elusive ability to mix text and graphics on the hi-res screen is now yours with Keith Brain's Graftext.

ONE OF the major criticisms of the Microsoft Extended Colour Basic as used on the Dragon 32 and the Tandy Colour Computer is that you cannot mix text and graphics on the high-resolution screen. In addition, colour in text mode is restricted to black on a green background. Well, like most facts, this is not strictly true if you are a trifle devious.

This Graftext program is a development of our Dragart program in November 1982's *Your Computer* and it achieves the aim of mixing text and graphics by Drawing the text on the high-resolution screen. This has the advantage that the text can be in any of the standard colours. It can also be of any reasonable size, and in four different directions on the screen.

Custom character sets and user-defined graphics are no problem, as of course the Draw command can be used to construct any shape you like. The whole of the program works immediately in response to Inkey$ commands. As the program is rather long the listing has many Rem statements to explain it. Remember that lower-case letters in the listing are inverse graphics on the screen.

On running the program, the instructions can be displayed, the resolution, foreground and background colours are selected, and checked for validity, and the appropriate high-resolution screen is then displayed.

At this point the program is in mode A, which operates in the same general way as direct drawing. The cursor draws in the colour selected by pressing the number corresponding to the required colour, in the direction selected by pressing U, D, L, R, E, F, G or H. The scale of drawing is increased by pressing S and reset to the default value by pressing X.

To Paint part of the screen press P: co-ordinates and colours will be requested. To Clear the screen use C, which requires that you confirm your request. To view the instructions press I, and press the Up cursor arrow to reach the Load and Save routines which allow you to dump high-resolution screens on to tape as machine-code files.

Pressing the @ key will move you into the new B mode where text — or user-defined characters — are generated and displayed. This has a larger cursor just below the current text line.

The most significant part of the program lies in lines 25-90. Line 25 evaluates the ASCII value of the key which has been pressed and uses this in an On-Gosub command to lead to

(continued on page 73)

(continued from page 71)
the line which contains the information to Draw that particular character.

The use of (ASC(C$)−32) means that the appropriate line number is conveniently the same as the ASCII code for that character. These characters are constructed on a six-by-five matrix, and at the end of each drawing there is a blank move to the next draw position. The smallest size of legible characters gives a display of 16 by nine in modes 0, 1 and 2 and of 32 by 19 in modes 3 and 4. This drawing of the text will occur in the colour, and at the scale, for !, you have selected in mode A.

To vary these @ must be pressed to return to mode A, the parameter changed, then @ pressed again to return to mode B to continue with the text. When the space bar is pressed criss-cross moves in the background colour are made at the next text position. This can also act as a way of deleting text. Using the cursor keys simply makes a blank move by one character size.

In the listing shown, some of the symbol keys have been replaced by accents to enable foreign text to be presented correctly in a further language-learning program. The accents automatically move back to the previous draw position. ASCII codes 32 for !, 60 for <, and 62 for >, have not been defined so far, so you can make these any character.

If you want more user-defined characters remember that all of the lower-case characters — reached by Shift 0 — are also available if you alter the valid key limits in line 350. ASCII code 64 is for @ and is never reached.

The angle of Drawing can be varied by pressing Enter when a tone is sounded to warn that the angle is about to be changed. A number — 0-3 — is then entered for normal, down, inverted or up text respectively. This direction is maintained until Enter is pressed again. This facility is particularly useful for labelling the axes of graphs. In mode B the Clear key is used to lead to the Clear Screen routine.

Try these examples to get an idea of the potential and then see what you can construct yourself.

RESOLUTION 1 BACKGROUND 1
FOREGROUND4
S(x5)D(x10)R(x10)H(x10)P20enter40enter2
enter4enter1R(x12)D(x4)XS
2@TRIANGLE↓←(x8)PAINTED IN↓ (x3)←(x10)
@4S@YELLOW
RESOLUTION 4 BACKGROUND 1
FOREGROUND 0
@ THIS IS A TEST enter 1DOWN enter 2UPSIDE DOWN enter1DOWN AGAIN enter0@S
@→BIG@S
BIGGER @X@enter3 SMALLER AND UP

The main character-drawing routines — 25-90 — can also be incorporated as subroutines in other programs to print messages, labels or scores which are stored in strings. This can be simply demonstrated by adding these lines:

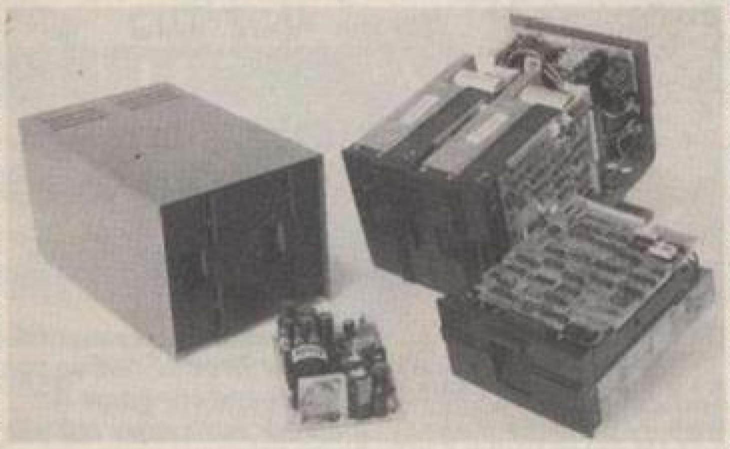
```
2000 PMODE4,1:SCREEN1,0:PCLS:D$="0"
2010LINEINPUT M$:FORN=1TOLEN(M$):
C$=MID$(M$,N,1):C=ASC(C$):GOSUB
25:NEXT
2020 PMODE4,1:SCREEN1,0:GOTO2000
```

Run 2000, enter a word, and it will be displayed from the default position centre of the high-resolution screen. ■

(listing continued from page 71)

```
249 REM IF KEY P THEN PAINT SUBROUTINE
250 IFA=80THEN600
259 REM IF KEY I THEN INSTRUCTIONS SUBROUTINE
260 IFA=73THENGOSUB1100:GOTO1000
269 REM IF KEY ^ THEN LOAD/SAVE SUBROUTINE
270 IFA=94THEN700
279 REM IF KEY IS A NUMBER BETWEEN 0 AND 8 UPDATE COLOUR ELSE EXECUTE DRAW COMMA
ND (U,D,L,R,E,F,G,H) WITH CURRENT COLOUR, ANGLE AND SCALE
280 IFA>47ANDA<57THENCB$="C"+A$ELSEDRAW"C"+CB$+"A"+C$+"S"+STR$(S)+A$
289 REM SOUND KEY NOTE AND RETURN TO CURSOR
290 SOUND(89+ASC(A$)),2:GOTO15
299 REM MODE B CURSOR
300 C$=INKEY$:IFC$=""THENDRAW"BM+2,+2;XCC$;R2L4R2;XCA$;R2L4R2BM-2,-2":GOTO300
309 REM SPACE
310 IFC$=" "THENDRAW"XCA$;U6RD6RU6RD6RU6RD6BM+3,+0":GOTO300
319 REM IF KEY @ RETURN TO MODE A
320 C=ASC(C$):IFC=64THEN15
329 REM IF KEY ENTER THEN GOTO ANGLE SUBROUTINE
330 IFC=13THEN420
339 REM IF KEY CLEAR THEN GOTO PCLS SUBROUTINE
340 IFC=12THEN500
349 REM IF KEY VALID FOR TEXT THEN GOTO DRAW TEXT SUBROUTINE
350 IFC>32ANDC<91THENGOSUB25:GOTO300
369 REM CURSOR MOVEMENTS
370 IFC=10THENM$="+0,+10"
380 IFC=8THENM$="-8,+0"
390 IFC=9THENM$="+8,+0"
400 IFC=94THENM$="+0,-10"
410 DRAW"S"+STR$(S)+"A"+D$+"BM"+M$:GOTO300
419 REM ANGLE CHANGING SUBROUTINE
420 D$=INKEY$:IFD$=""THENSOUND220,2:GOTO420
430 D=ASC(D$):IFD<48ORD>51THENGOTO420ELSEGOTO300
499 REM SCREEN CLEARING SUBROUTINE
500 CLS4:PRINT"CLEAR SCREEN (Y/N)";:INPUTD$:IFD$<>"Y"THENGOTO1000ELSEPCLS:GOTO10
00
599 REM PAINT SUBROUTINE
600 CLS0:PRINT"PAINT COORDINATES";:INPUTP1,P2:PRINT"PAINT COLOUR";:INPUTPC:PRINT
"BORDER COLOUR";:INPUTBC
610 PMODEZ,1:SCREEN1,Y:PAINT(P1,P2),PC,BC:GOTO15
699 REM LOAD/SAVE SUBROUTINE
700 CLS4:PRINT@5,"TAPE ROUTINE":PRINT@69,"S = SAVE":PRINT@133,"L = LOAD"
710 PRINT@197," ";:INPUTT$:IFT$<>"S"ANDT$<>"L"THEN710
720 PRINT@261,"FILENAME":FORN=1TO7:PRINTCHR$(128);:NEXT:PRINT@298," ";:INPUTF$:
IFLEN(F$)>7THENPRINT@298,"                TOO LONG":GOTO720:ELSEF$="M"+F$:PRINT@384
,"WHEN TAPE READY PRESS SPACEBAR"
730 IFINKEY$=""THEN730
740 IFT$="S"THENPRINT@384,"SCREEN SAVING":CSAVEMF$,1536,(1536+(1536*PG)),(1536*P
G):FORN=1TO4:PRINT@384,"SCREEN SAVED":SOUND1,5:PRINT@384," ":SOUND50,5:NEXT:GOTO
1000
750 IFT$="L"THEN PMODEZ,1:SCREEN1,Y:COLOR CB,CA:CLOADMF$:GOTO15
799 REM START ROUTINE
800 CLS:PRINT@32,"graftext",,,"THIS PROGRAM ALLOWS YOU TO","USE MIXED TEXT AND
GRAPHICS","ON THE HIGH-RESOLUTION SCREEN",,,"FOR INSTRUCTIONS ENTER 'I'",,,"OTHE
RWISE PRESS RETURN","TO CONTINUE",,,,,,"COPYRIGHT K & S BRAIN 051282":PRINT@38
4," ";:ST=1
810 INPUTQ$:IFQ$="I"THENGOSUB1100
820 CLS:PRINT," hi-res modes":PRINT@97,"0 = 128 X 96  ( ";CHR$(128);" ) TWO CO
LOUR":PRINT@161,"1 = 128 X 96  ( ";CHR$(128);" ) FOUR COLOUR":PRINT@225,"2 = 192
 X 128 ( ";CHR$(138);" ) TWO COLOUR":PRINT@289,"3 = 192 X 128 ( ";CHR$(138);" )
FOUR COLOUR"
825 PRINT@321,,"  4 = 256 X 192 ( ";CHR$(142);" ) TWO COLOUR":PRINT@455,"resolut
ion required";
830 INPUTZ:IFZ>4THENPRINT@450,"INVALID REQUEST";:GOTO830
840 IFZ=0ORZ=2ORZ=4THEN1020
900 CLS:PRINT"FOUR COLOUR MODE",,,"COLOUR SET 1",,,,"1 = ";CHR$(143);" GREEN","2
 = ";CHR$(159);" YELLOW","3 = ";CHR$(175);" BLUE","4 = ";CHR$(191);" RED"
910 PRINT,,,"COLOUR SET 2",,,,"5 = ";CHR$(207);" BUFF","6 = ";CHR$(223);" CYAN"
,"7 = ";CHR$(239);" MAGENTA","8 = ";CHR$(255);" ORANGE"
920 PRINT@416,"BACKGROUND COLOUR";:INPUTCA$:PRINT"FOREGROUND COLOUR";:INPUTCB$
930 CA=VAL(CA$):CB=VAL(CB$):IFABS(CA-CB)>3ORCA=0ORCB=0THENPRINT@480,"invalid com
bination";:GOTO920
940 IFCA<5THENY=0ELSEY=1
950 CC$="C"+STR$(Y)
999 REM HI-RES SCREEN SET UP
1000 PMODEZ,1:SCREEN1,Y:COLOR CB,CA:IFST=1THENPCLS:ST=0
1009 REM SET VARIABLES
1010 CA$="C"+CA$:CB$="C"+CB$:PG$="12244":PG=VAL(MID$(PG$,Z+1,1)):B$="ICUDLREFGHS
XP0123456780":S=4:D$="0":DRAW"S4BM10,10":GOTO15
1020 CLS:PRINT"TWO COLOUR MODE",,,,"COLOUR SET 1",,,,"0 = ";CHR$(128);" BLACK"
,"1 = ";CHR$(143);" GREEN"
1030 PRINT,,,"COLOUR SET 2",,,,"0 = ";CHR$(128);" BLACK","5 = ";CHR$(207);" BUF
F"
1040 PRINT@416,"BACKGROUND COLOUR";:INPUTCA$:PRINT"FOREGROUND COLOUR";:INPUTCB$
1050 CA=VAL(CA$):CB=VAL(CB$):IFCA=1ORCA=5ANDCB=0THEN1080
1060 IFCB=1ORCB=5ANDCA=0THEN1090
1070 PRINT@480,"invalid combination";:GOTO1040
1080 IFCA=1ORCB=1THENY=0:CC$="C"+CB$:GOTO1000
1090 Y=1:CC$="C"+CB$:GOTO1000
1099 REM INSTRUCTIONS
1100 CLS:PRINT"instructions":PRINT@64,"IN MODE A A SMALL CURSOR APPEARS",,"TO MO
VE PRESS 'U D L R E F G H'",,,"TO INCREASE SCALE PRESS 'S'",,,"TO RESET SCALE PR
ESS 'X'",,,"TO CHANGE TO NEW DRAW COLOUR","PRESS APPROPRIATE NUMBER KEY":GOSUB12
00
1110 PRINT"MODE A",,,,"TO ERASE DRAW WITH THE","BACKGROUND COLOUR",,,"FOR INSTRU
CTIONS PRESS 'I'",,,"TO ENTER MODE B PRESS '@'",,,"TO PAINT PRESS 'P'",,,"TO CLE
AR SCREEN PRESS 'C'":GOSUB1200
1120 PRINT"IN MODE B CURSOR IS LARGER",,"TO MOVE USE CURSOR (ARROW) KEYS",,,"TO
 WRITE PRESS APPROPRIATE KEY",,,"TO CHANGE ANGLE OF WRITING PRESSENTER AND THEN
NUMBER (0-3)",,,"TO CHANGE OTHER PARAMETERS PRESS@ AND RETURN TO MODE A":GOSUB12
00
1130 PRINT"MODE B",,,,"TO CLEAR SCREEN PRESS CLEAR",,"PRESS @ TO RETURN TO MODE
 A",,,,,"PRESS ^ IN MODE A FOR LOAD/SAVE","ROUTINE":GOSUB1200:RETURN
1200 PRINT@480,"press enter to continue";:INPUTN:CLS:RETURN
```

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Formatted (16 sectors, 128/256 bytes)			
Per disk	163.84 kbytes	327.68 kbytes	655.36 kbytes
Per track	2.1 kbytes	4.1 kbytes	4.1 kbytes
Code	MFM	MFM	MFM
Transfer Rate	125 kbits/s	250 kbits/s	250 kbits/s
Average latency	less than 100 ms	less than 100 ms	less than 100 ms
Seek Time			
Track to track	less than 5 ms	less than 5 ms	less than 5 ms
Average Access	less than 80 ms	less than 80 ms	less than 132 ms
Setting time	less than 15 ms	less than 15 ms	less than 15 ms
Head Load Time (OPT)	less than 50 ms	less than 50 ms	less than 50 ms
Media	hard/soft sector	hard/soft sector	hard/soft sector

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Number of Tracks	40	80
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THE Z/L RANGE

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SPECTRUM TOOL KIT



Bobby Rao offers some handy hints to would-be machine-code users. Here are some useful off-the-peg routines.

HERE ARE ABOUT 20 machine-code graphics routines, any combination of which may be used in your programs to enhance the screen displays, or to give them that extra touch of elegance that comes only from the use of machine code. Also included are renumber and memory-left routines which may be used to aid your programming.

No understanding of machine code is necessary to use the routines — just a good working knowledge of the Spectrum and its manual. Machine code is the computer's first language — it only speaks Basic out of courtesy to humans — and its use results in greater speed, flexibility and more economical use of memory than does the use of Basic.

To get the machine code into the computer a hex loader must be used — see program 1. Type this in and Save it. Machine code can either be stored above RAMtop or in a Rem statement at the beginning of a program. I prefer the latter method, for each different routine may be stored in a Rem statement with a different line number and then Merged into a program as required. However, if you wish to use the first method then change line 5 as shown underneath the program listing.

Here is an example of how you go about loading in the memory-left routine, see figure 1. Firstly Load in the hex loader and type in a Rem statement as line 1. This Rem statement should consist of 14 full stops because the memory-left routine is 14 bytes — characters — long. If you are using the RAMtop method then you will not need to do this — just Clear yourself enough memory space above RAMtop. Now carefully type in the Data line in figure 1 and after checking this line Run the program. Listing it will show that line 1 is now a meaningless jumble — if you have a line 1, that is — but do not worry, for this is supposed to happen. Also it is likely that Listing the program when the Rem line is in this state will cause the computer to stop with an error report. To avoid this and view the rest of the program you must always use List — line number of first line after Rem line — so that the Spectrum does not try to List the unlistable Rem line.

Now the routine is ready to be Saved. Erase all of the hex loader except the Rem line — do not use New whatever you do — and Save this with a filename like "Mem Left". Now New the computer and reload the hex loader. Repeat the above process for the rest of the routines, but make sure you never use the same Rem line number for two different routines because this will cause trouble when you come to Merging routines together.

RAMtop-method users may Save their routines by using the Save filename Code method detailed in the manual on pages 143 and 180.

Once the tedious task of typing in and Saving the routines has been accomplished you are ready to use the routines. If you wish to use some of the routines in one of your programs then start that program at, for example, line 100, leaving the earlier line numbers free for the machine-code Rem lines. After typing in the program, Merge in the routines you require. To run machine code rather than Basic the Usr function must be used.

The argument of this function is the address of the first byte of the machine-code routine you want to run, and this may be found, if you are using the Rem method, by using program 2. On running this program — whilst the machine-code routines are in the computer — line numbers and the start addresses of the routines in those lines are printed until the computer finds a non-Rem line when it will Stop. Note these start addresses down, or better still, define variables equal to these values by placing a lot of Let statements somewhere in your program, for example:

```
LET INV=23760
```

Now just typing Print Inv will tell you the address of the first byte of the invert-screen routine.

RAMtop method users will not need to use program 2 because they will already know the addresses of their routines or they would not have been able to get them above RAMtop in the first place.

To use the routines use the command Randomise OX USR X, where X is the address of the routine you are using. The result of the Usr function is multipled by 0 to keep Rnd truly random, that is, it acts like a Randomise O command.

Below there is a description of all the routines and how to use them. In these descriptions the variable X stands for the address of the first byte of the routine in question. All numbers are in decimal and unless otherwise stated all the screen routines operate on all 24 lines of the screen.

Where you are told to Poke something somewhere the Pokes must be done before you use the routines and they may be entered as a series of direct commands before you Run the program or they may be built into the program.

Memory Left: running this, listing 1, using Print Usr X will tell you the exact number of free bytes of memory you have left.

Hi-Res Up Scroll: this, listing 2, routine scrolls the screen up by one high-res pixel, replacing the bottom line of pixels with blanks.

Hi-Res Down Scroll: as in listing 2, but this — listing 3 — scrolls down, blanking the top line of pixels.

Hi-Res Left Scroll: this scrolls the screen left one pixel, replacing the rightmost column of pixels with blanks. See listing 4.

Hi-Res Right Scroll: as in listing 4, but listing scrolls right, blanking the leftmost column of pixels.

One Character Left Scroll: the listing 6 routine scrolls the screen left one character, replacing the rightmost column with either blanks — for this effect Poke X+16,54 — or the previous leftmost column — a wrap-around effect for this Poke X+16,119.

One Character Right Scroll: the listing 7 routine scrolls right. Poke X+16,54 causes the leftmost column to be blanked and Poke X+16,119 replaces this column with the previous rightmost column.

These last two routines are adjustable in which part of the screen they scroll but you only have five options. The table below tells you how to adjust the routines. The first column tells you which part of the screen is to be scrolled. The next two columns tell you what to Poke in X+I and in X+4 respectively for the left scroll routine. The last two columns tell you what to Poke in X+I and X+4 respectively for the right scroll routine.

Top one-third	64	64	64	71
Middle one-third	64	72	64	79
Bottom one-third	64	80	64	87
Top two-thirds	128	64	128	79
Bottom two-thirds	128	72	128	87

Invert Screen: the listing 8 routine inverts the actual pixels on the screen, that is, all pixels on are turned off and all pixels off are turned on and so it is different from the Inverse function on the Spectrum which only

(continued on page 81)

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NOTE

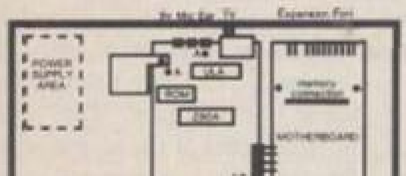
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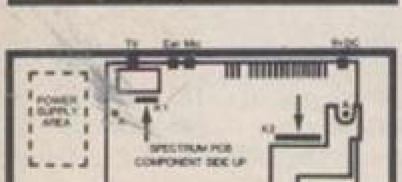
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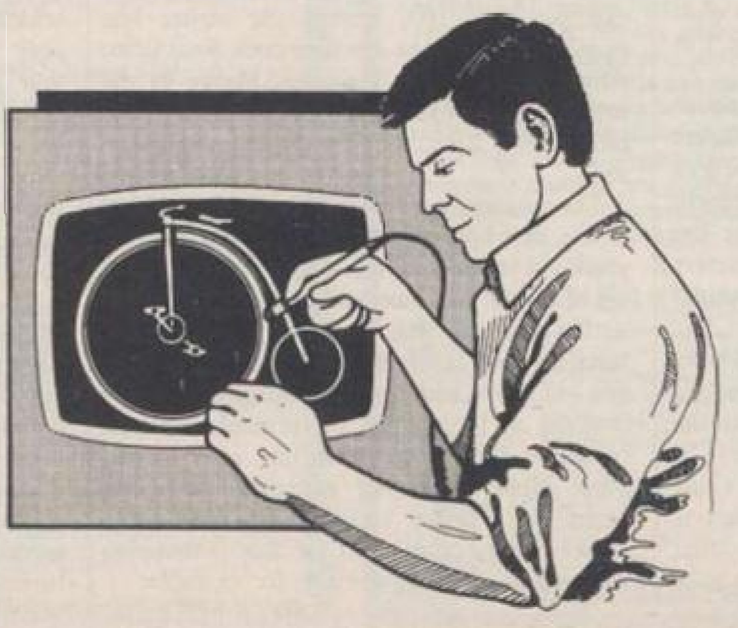
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(continued from page 77)

inverts the Ink and Paper colours — which this routine does not alter.

Screen Fill: this routine, listing 9, fills in a box of height a, width b, and a top left-hand corner at a point c,d — where c and d are co-ordinates used by the Print At system — with any character of your choice.

POKE X+1, character-code POKE X+3,a
POKE X+4,c POKE X+6,b POKE X+7,d

So if a=22, b=32,c=0, and d=0 then the normal 22-line screen is filled. You must have Printed something somewhere before using this routine or it will not work properly. Also note that you cannot Print on line 24 with this routine.

Ink Change: this — see listing 10 — changes the Ink colour of the screen without altering anything else. Poke X+1, the number of the colour you want to change the Ink to.

Paper Change: as listing 10 but changes the Paper colour. Poke X+1, the number of the colour you want to change the Paper to. See listing 11.

Flash On-Off: this routine, listing 12, sets the whole screen flashing — for this Poke X+9,254 — or returns the screen to normal non-flashing mode — for this Poke X+9,190.

Bright On/Off: the routine shown in listing 13 makes the whole screen bright — Poke X+9,246 — or returns it to normal brightness — Poke X+9, 182.

Attr Fill: the fourteenth listing changes the attributes for a box height a, width b and of top left-hand corner at a point c,d where c and d are co-ordinates used by the Print At system to denote a point on the screen.

POKE X+3,d POKE X+4,c POKE X+6,b POKE X+7,a

Poke X+1, the value you want to change the attributes to. This value may be calculated thus: first assume the new Attr value is Y and initially Y=0. If Flash is on add 128 to Y, if off add 0. If bright is on add 64 to Y, if off add 0. Add eight times the number of the Paper colour to Y. Add the number of the Ink colour to Y.

This means that an attribute of flashing, bright blue Ink on yellow paper would be 128+64+(1×8)+6=206.

With this routine you can change the attributes of the whole 24-line screen.

Attr. Up Scroll: this routine, listing 15, allows you to scroll up the attributes for a box height a, width b, and top left-hand corner at a point c,d. The bottom line of the box is replaced with an attribute of value Y — see Attr Fill for how to calculate Y

POKE X+1,n POKE X+3,d POKE X+4,c
POKE X+6,b POKE X+7,a

Attr Down Scroll: listing 16 scrolls down replacing the top line of the box with the new attribute. The Pokes are the same as for the previous routine.

Attr Left Scroll: as listing 16 but scrolls left replacing the rightmost column of the box with either a new attribute — for this Poke X+36,0 — or with what was previously in the leftmost column of the box — for this Poke X+36, 26 — This last effect, wrap-around, allows this routine to be used fully with the one character left scroll routine given above. See listing 17.

Attr Right Scroll: the routine shown in listing 18 scrolls right, replacing the leftmost column of the box with either a new attribute — for this Poke X+43, 0 — or with what was previously in the rightmost column of the box — for this Poke X+43, 26. This last effect allows this routine to be used fully with the one character right scroll given previously.

The next three routines allow you to store screens currently being displayed in spare memory and then recall them on to the display either making them swap memory position with the screen currently being displayed, or Overprinting them on to the current display. To store screens you must firstly Clear some memory space so you can store the screens there. each screen — with attributes — is 6,912 bytes long so this much space is required for each screen.

The memory location of RAMtop — the last byte of the computer's memory — can be found by using Print — Peek 23730+256 X Peek 23731. If this number is W then W–QX 6912 — where Q is the number of screens to be stored — will tell you the address to Clear RAMtop to — see manual page 168. You must have cleared this space or the routines will not function correctly.

If you only have 16K of memory then space exists for storing only one screen so Clear 25685 is all you need to use. In order that the routines know where in the memory a screen is to be fetched from or sent to you must do the following for all the routines:

POKE X+I, W-INT (W/256)
POKE X+2 INT (W/256)

If you have 48K and you wish to store more than one screen then it might be advisable to leave a gap of a few bytes in between screens so as to lower the risk of one screen running over on to another by accident.

If you are using the RAMtop method for storing the machine-code routines then be extra careful, or you will end up ruining the routines and crashing the computer. Make sure you take into account the length of the routines when deciding where you Clear RAMtop to.

Store Screen: This replaces the current display with one already in the memory. See listing 19.

Swap Screens: This routine swaps the current display with one higher up in the memory so that the screen that was being displayed is stored in the memory and the screen that was in the memory is now displayed. See listing 20.

Over Print Screens: This overprints a screen from higher up in the memory on to the current display. The old display is lost in its original form — it is not stored anywhere by this routine before it is altered — but the screen used to Print Over the old display still remains intact higher up in the memory. The attributes are not changed by this routine so after the routine has been used the attributes being displayed are those of the old display. See listing 21.

Renumber: this routine, listing 22, instantly renumbers all the line numbers of your program starting the first line at a specified value and increasing this value by a specified amount as it renumbers the rest of the lines. Note that this does not change the Gotos and Gosubs so you will have to alter these manually. If the first line is renumbered L and the value by which L is increased is M then:

POKE X+5, M -INT(M/256)
POKE X+(INT(M/256)
POKE X+8, L -INT(L/256)
POKE X+9, INT(L/256)

For fun you might try renumbering all lines 0 or try using a starting value greater than 9999.

The uses of these routines are many and varied, limited only by the imagination of the user. For example, the left and right scrolls with wrap-around may be used to create a constantly moving background for a space game. Any of the scrolling routines may be used to clear all or part of the screen in a novel way.

The Ink and Paper changing routines may be used to create a surprise effect by first drawing a picture on the screen using the same Ink and Paper colour and then altering either so that the picture appears instantly. Animated cartoon effects are possible using the screen swapping routines and stunning explosion effects may be simulated by using the Invert Screen routine repeatedly — in a loop. The list is endless and these are just a few broad guidelines that you can experiment with and doubtless improve on.

Just as a bit of fun try the following Poke next time you have a program in your Spectrum, Poke 23606, 8. This makes the computer speak Russian — nearly. Poke 23606,0 restores normality.

Program 1. Hexloader

```
   1 REM ...Enough full stops to
 hold the machine code routine..
   5 LET a=5+PEEK 23635+256*PEEK
 23636
  10 FOR n=a TO a+200: READ a$
  15 LET x=CODE a$-48-(39*(a$>"£
")): LET y=CODE a$(2)-48-(39*(a$
(2)>"£"))
  20 POKE n,x*16+y: NEXT n
```

```
RAMTOP method users change
line 5 to:
5 CLEAR x: LET a=x
where x is the address they need
to move RAMTOP to.
```

Program 2. Start of line finder.

```
9000>REM start of line finder
9010 LET a=PEEK 23635+256*PEEK 2
3636
9020 CLS : PRINT "LINE No.","ADD
RESS"
9030 IF PEEK (a+4)<>234 THEN STO
P
9040 PRINT PEEK a*256+PEEK (a+1)
,a+5
9050 LET a=a+4+PEEK (a+2)+256*PE
EK (a+3)
9060 GO TO 9030
```

Listing 2.

```
 100>REM HI-RES UP SCROLL
     97 bytes long
 102 DATA "21","00","40","06","0
3","c5","06","00","c5","06","07"
,"c5","06","20","e5","11","00","
01","19","d1","7e","12","eb","23
","10","f4","11","e0","00","19",
"c1","10","ea"
 104 DATA "c1","78","fe","01","2
0","1a","c5","06","20","11","e0"
,"06","e5","a7","ed","52","d1","
7e","12","eb","23","10","f2","11
","00","07","a7","ed","52","c1",
"10","c7"
 106 DATA "c1","78","fe","01","2
0","12","c5","06","20","11","20"
,"00","e5","19","d1","7e","12","
eb","23","10","f4","c1","10","ec
","06","20","36","00","23","10",
"fb","c9"
```

Listing 3.

```
 100>REM HI-RES DOWN SCROLL
     99 bytes long
 102 DATA "21","ff","57","06","0
3","c5","06","00","c5","06","07"
,"c5","06","20","e5","11","00","
01","a7","ed","52","d1","7e","12
","eb","2b","10","f2","11","e0",
"00","a7","ed","52","c1","10","e
6"
 104 DATA "c1","78","fe","01","2
6","16","c5","06","20","11","e0"
,"06","e5","19","d1","7e","12","
eb","2b","10","f4","11","00","07
","19","c1","10","e7"
 106 DATA "c1","78","fe","01","2
6","13","c5","06","20","11","20"
,"00","e5","a7","ed","52","d1","
7e","12","eb","2b","10","f2","c1
","10","aa","06","20","36","00",
"2b","10","fb","c9"
```

(continued on page 83)

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(continued from page 81) Listing 1.

```
100>REM MEMORY LEFT
     14 bytes long
 102 DATA "21","00","00","39","e
d","5b","65","5c","a7","ed","52"
,"e5","c1","c9"
```

Listing 4.

```
100>REM HI-RES LEFT SCROLL
     32 bytes long
 102 DATA "21","00","40","06","c
0","c5","06","1f","7e","cb","27"
,"77","23","7e","cb","27","77","
30","06","2b","7e","cb","c7","77
","23","10","f1","23","c1","10",
"e6","c9"
```

Listing 5.

```
100>REM HI-RES RIGHT SCROLL
     32 bytes long
 102 DATA "21","ff","57","06","c
0","c5","06","1f","7e","cb","3f"
,"77","2b","7e","cb","3f","77","
30","06","23","7e","cb","ff","77
","2b","10","f1","2b","c1","10",
"e6","c9"
```

Listing 6.

```
100 REM 1 CHR. LEFT SCROLL
     25 bytes long
 102 DATA "06","c0","11","00","4
0","d5","e1","23","c5","01","1f"
,"00","1a","ed","b0","2b","77","
00","23","23","13","c1","10","f0
","c9"
```

Listing 7.

```
100>REM 1 CHR. RIGHT SCROLL
     25 bytes long
 102 DATA "06","c0","11","ff","5
7","d5","e1","2b","c5","01","1f"
,"00","1a","ed","b8","23","77","
00","2b","2b","1b","c1","10","f0
","c9"
```

Listing 8.

```
100>REM INVERT SCREEN
     19 bytes long
 102 DATA "21","00","40","06","1
8","c5","06","00","7e","ee","ff"
,"77","23","10","f9","c1","10","
f3","c9"
```

Listing 9.

```
100>REM SCREEN FILL
     30 bytes long
 102 DATA "0e","40","21","16","0
0","11","20","00","45","d5","c5"
,"43","3e","16","d7","7c","d7","
7a","d7","79","d7","14","10","f4
","24","c1","d1","10","ec","c9"
```

Listing 10.

```
100>REM INK CHANGE
     25 bytes long
 102 DATA "3e","05","e6","07","5
7","21","00","58","06","03","c5"
,"06","00","7e","e6","f8","b2","
77","23","10","f8","c1","10","f2
","c9"
```

Listing 11.

```
100>REM PAPER CHANGE
     31 bytes long
 102 DATA "3e","00","cb","27","c
b","27","cb","27","e6","38","57"
,"21","00","58","06","03","c5","
06","00","7e","e6","c7","b2","77
","23","10","f8","c1","10","f2",
"c9"
```

Listing 12.

```
100>REM FLASH ON/OFF
     17 bytes long
 102 DATA "21","00","58","06","0
3","c5","06","00","cb","fe","23"
,"10"."fb","c1","10","f5","c9"
```

Listing 13.

```
100>REM BRIGHT ON/OFF
     17 bytes long
 102 DATA "21","00","58","06","0
3","c5","06","00","cb","f6","23"
,"10","fb","c1","10","f5","c9"
```

Listing 14.

```
100>REM ATTR FILL
     44 bytes long
 102 DATA "3e","64","01","00","0
0","11","20","18","21","df","57"
,"d5","11","20","00","04","19","
10","fd","41","04","23","10","fd
","d1","42","e5","48","43","77",
"23","10","fc","e1","d5","11","2
0","00","19","d1","41","10","ef"
,"c9"
```

Listing 15.

```
100>REM ATTR UP
     55 bytes long
 102 DATA "3e","2f","01","00","0
0","11","20","16","21","df","57"
,"f5","d5","11","20","00","04","
19","10"."fd","41","04","23","10
","fd"
 104 DATA "d1","42","05","c5","0
6","00","4b","d5","e5","11","20"
,"00","19","d1","e5","ed","b0","
e1","d1","c1","78","10","ec","f1
","43","77","23","10","fc","c9"
```

Listing 16.

```
100>REM ATTR DOWN
     62 bytes long
 102 DATA "3e","2f","01","00","0
0","11","20","16","21","df","57"
,"15","f5","78","82","47","79","
83","4f","d5","11","20","00","04
","19","10","fd"
 104 DATA "41","23","10","fd","d
1","42","c5","05","00","4b","d5"
,"e5","11","20","00","a7","ed","
52","d1","e5","ed","b8","e1","d1
","c1"
 106 DATA "78","10","ea","f1","4
3","77","2b","10","fc","c9"
```

Listing 17.

```
100>REM ATTR LEFT
     52 bytes long
 102 DATA "3e","2f","01","00","0
0","11","20","18","21","df","57"
,"f5","d5","11","20","00","04","
19","10","fd","41","04","23","10
","fd","d1"
 104 DATA "42","f1","c5","06","0
0","4b","0d","d5","e5","d1","1a"
,"d5","23","ed","b0","12","e1","
11","20","00","19","d1","c1","10
","e9","c9"
```

Listing 18.

```
100>REM ATTR RIGHT
     61 bytes long
 102 DATA "3e","2f","01","00","0
0","11","20","18","21","df","57"
,"15","f5","78","82","47","79","
83","4f","d5","11","20","00","04
"
 104 DATA "19","10","fd","41","2
3","10","fd","d1","42","04","f1"
,"c5","06","00","4b","0d","d5","
e5","d1","1a","d5","2b","ed","b8
","12","e1","11","20","00","a7",
"ed","52","d1","c1","10","e7","c
9"
```

Listing 19.

```
100>REM STORE SCREEN
     12 bytes long
 102 DATA "11","32","64","21","0
0","40","01","00","1b","ed","b0"
,"c9"
```

Listing 20.

```
100>REM SWAP SCREENS
     28 bytes long
 102 DATA "11","32","64","21","0
0","40","06","18","c5","06","00"
,"c5","7e","f5","1a","47","f1","
a8","77","23","13","c1","10","f3
","c1","10","ed","c9"
```

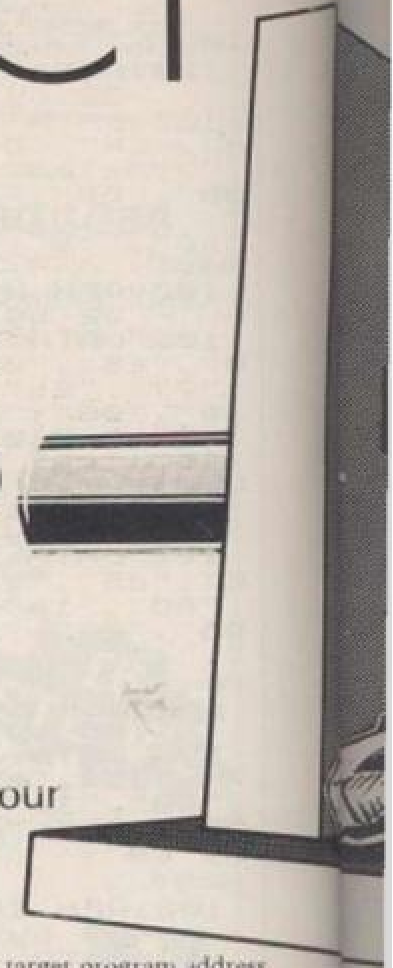
Listing 21.

```
100>REM OVER PRINT SCREENS
     25 bytes long
 102 DATA "11","32","64","21","0
0","40","06","1b","c5","06","00"
,"7e","f5","1a","77","f1","12","
23","13","10","f6","c1","10","f0
","c9"
```

Listing 22.

```
100>REM RENUMBER
     38 bytes long
 102 DATA "ed","6b","53","5c","0
1","0a","00","11","64","00","d5"
,"e5","ed","5b","4b","5c","af","
ed","52","e1","d1","c8","c5","72
","23","73","23","4e","23","46",
"23","09","eb","c1","09","eb","1
8","e4"
```

COMPACT BASIC: EASY AS ABC



Slim down those outsize programs to fit your memory with David Berry's Atom Basic Condenser routine — ABC.

ATOM BASIC CONDENSER or ABC can perform all the compaction functions and remove Rems, spaces, unnecessary brackets, and variables from Next commands. All commands may be converted to their short-form version and program lines concatenated to produce lines of up to 254 characters in length. All of these functions are menu-selectable and are programmed into ABC at the start of the run.

If you now look at the listing you will see the ABC itself is compacted. When you type the program in you will have to break the long lines down into two or more shorter ones. Enter the program into the upper text space using short-form commands throughout.

Now type Run, then Esc and Print &I. and enter the machine code listed in figure 2. You can now use ABC in the upper text space, but if you want to be able to use it in either text space you will now have to copy each routine into lower text space and compact it using ABC.

Store each routine on tape, and when they are all compacted, assemble them into one program in the lower text space. Again type Run then Esc and Print &L. Then enter the machine code listed in figure 2. If you tried compacting the machine code you will already have found out that it is not advisable. Once you have done this ABC is complete.

ABC may be loaded from tape into either text space. If it is loaded into the lower text space starting at # 2900 it will almost completely fill the available RAM and the value of Top will be # 3BFB. This means that if you see any of the inverted |@| markers to preserve line numbers referenced by Goto, Gosub and similar commands, the interpeter will generate an "out-of-memory" error — error 30 — because it is trying to dimension an array element in non-existent RAM locations above # 3BFF.

```
L-1  =EA
L    =A4
L+1  =80 THEN: A9 00 85 80 C8 F0 10 B1 80
      8D 02 B0 88 91 80 C9FF F0 1B C8 C8
      D0 F0 E6 81 B1 80 C6 81 88 91 80 E6
      81 C8 C8 4C D0 3B EA EA 20 71 FE 84
      88 60 22 0D FF
```

Figure 2. Machine code to be entered from L-1 onward.

There are two simple solutions to this problem: first the program could be *Loaded into the lower text space starting at # 2800:

*LOAD"ABC"2800

The second solution is to change the parameter A in line 30 of the program. A holds the base-address of the array and is normally set to Top. This can be changed to store the array anywhere in memory. It may be set to # 2800, when the array will be stored in the bottom part of the lower text space, or to # 8100 when the array will use the lower half of the screen,or to # 2920 which will cause the array to be stored inside ABC itself.

If you choose the latter option you will, of course, be overwriting part of ABC — the menu — which will have already been finished with by the time the array is set up. You will not afterwards be able to Run the program again without reloading it.

This problem does not occur if ABC is loaded into the upper text space where more RAM is available above the program. So load ABC into your chosen text space with the *Load command:

*LOAD"ABC"2900
*LOAD"ABC"2800
*LOAD"ABC"8200

Next load the target program, that is, the program to be reformed, and mark any lines referenced by Goto, Gosub and similar commands with the dummy lable |@| — inverted @. I have used a line on either side of a character to show that it is inverted.

```
0320 GOTO 0400
0400|@|REM This line number will be saved.
```

These line numbers will be the only ones preserved after processing is complete — all others will be renumbered. Any number of |@| labels may be used and ABC removes them after processing.

Now point the interpreter to ABC by changing the contents of location 18.

?18 = # 28
?18 = # 82

To execute ABC type Run. Immediately after the run starts the menu is printed. The available options are:

|C| Short - form commands
|N| Remove variable from text
|P| Remove all parenthesis
|R| Remove all Rem statements
|S| Remove all spaces
|W| Wrap all Basic lines

The capital letters are inverted characters.

The program then asks you to Input a command string. This is made up of one or more menu selections — inverted capital letters; these are the actual labels used to control the program jumps — entered immediately after one another.

|C|N|S|
|S|
|C|N|P|R|S|W|

ABC then prompts for the most significant byte — MSB — of the target program address. For example in a program at 2900 the MSB is # 29, and in a program at 8200 the MSB is # 82.

Note that these are MSBs of the target program, not ABC.

All command-string entries are verified. ABC will not accept any entry which is not one of the inverted letters |C|N|P|R|S|W|. If an incorrect entry is made the command string is printed, the incorrect entry indicated, and a correction requested. During this correction phase you may enter an inverted |B| which is a dummy activity — B = blank — and can thus be used to eliminate an entry if required.

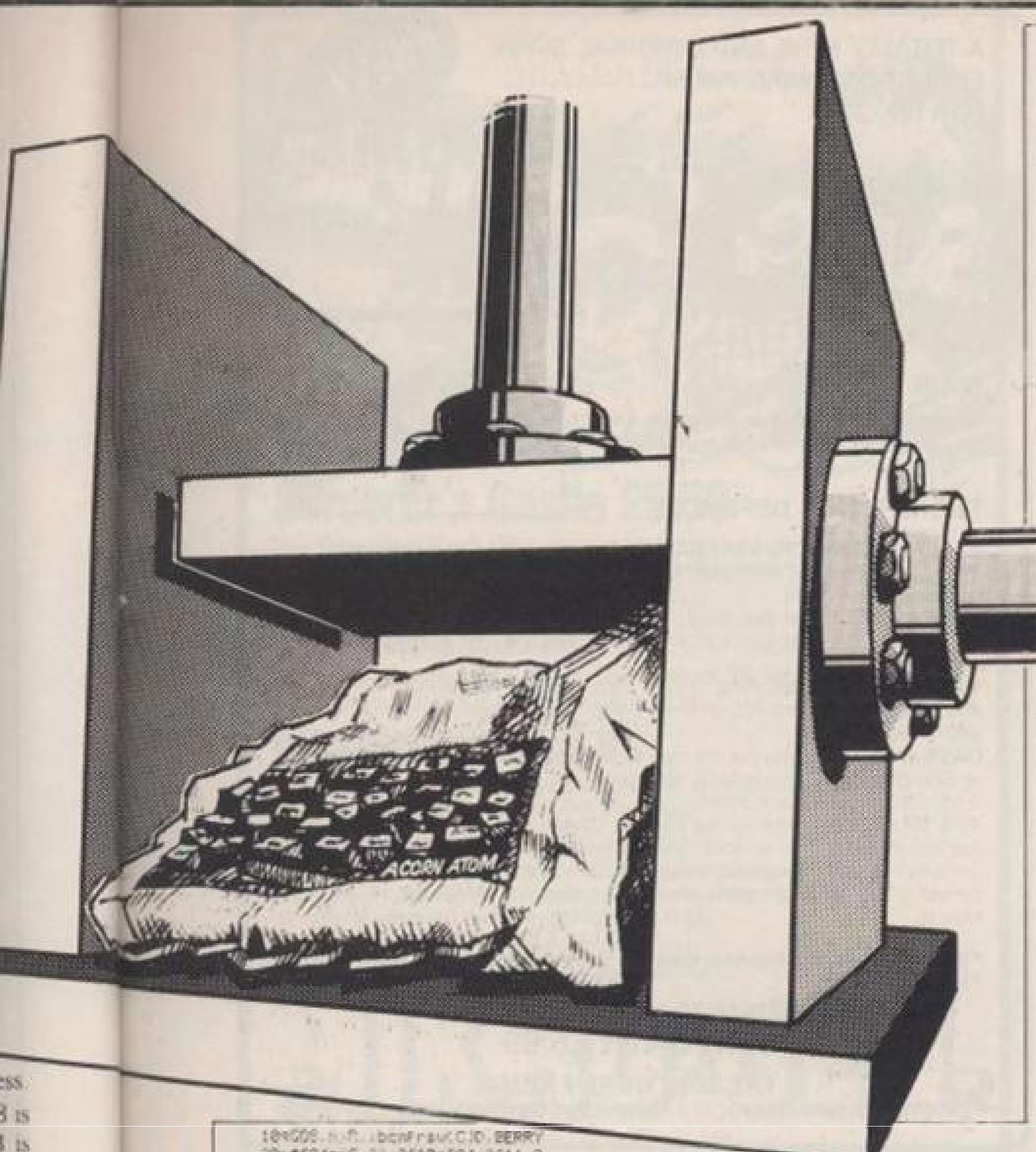
ABC also contains an error-trapping routine which ensures that if any run-time errors occur the target program is not left in a semi-processed state.

At the start of each routine the bell is rung. If any key is pressed immediately after the bell, that routine is skipped. If no key is pressed the activity continues after a short pause.

ABC is of modular construction. Once the command string is entered, processing is effected by a series of calls to subroutines. The actual subroutines called, and the order of their calls, is controlled by the command string entered. Two routines are always called: the initialising routine and the terminating routine, and these take care of the housekeeping.

The initialising routine changes all the line numbers in the target program to zero, stores any line numbers marked with the dummy label inverted |@| and replaces spaces in For, Until and If statements — that are necessary for their correct interpretation — with inverted blanks — ASCII # 80.

This short-form routine — S — replaces all Basic commands with their short-form



```
10 GOS.[illegible] BERRY
20 #E04=[illegible]G.[illegible]?E10=E04;?E11=0
30A=TOP;?ED=A%E100;?EE=A/E100;?E23=?ED;?E24=?EE
40C=E0002;O=0;P.$12,"        A B C   M E N U";P."c SHORT FORM COMMANDS";P.
"n REMOVE VARIABLE FROM NEXT";P."p REMOVE PARENTHESIS";P."r REMOVE ALL REM
STATEMENTS";P."s REMOVE ALL SPACES";P."w WRAP ALL BASIC LINES"
50P."COMMAND STRING ";"TEXT AREA MSB ";$E0;IN.$E21C;"TEXT AREA MSB "J;J=J*
E100;GOS.a;IF?J<>ED P.$12$7"ERR.J<>ED";E.
60L=?E390*E100+?E38F+5;L?E27=(L+9)%E100;L?E28=(L+9)/E100;I=?E12*E100+?E13;F.G
=E21C TO(E21C+L,E21C-1);T=1;F.R=I+13 TOI+19;IF?G=?R;T=0
70N.;IFT;GOS.s
80IF?G=E7?GOS.[illegible]
90N.[illegible]GOS.[illegible]O=0;DOI[illegible]E21C;GOS.[illegible]O=O+1;U.?(E21C+E0)[illegible]GOS.[illegible]P.$1
2"[illegible]** SUCCESSFUL TERMINATION **";E.
100[illegible]IF?M=ED[illegible]G.o
110IF?M=E22 DOM=M+1;U.?M=E22;M=M+1;G.o
120?O=M;R.
130IF.$7;T=0;DOT=T+1;LI.(L+E2A);WAIT;U.T=3000OR?E80<>EFF;P.$7;R.
140eP.$12 $7;"COMMAND STRING ERROR DETECTED";P.;"PERMITTED CODES ARE ";P.
c n p r s w";F.$E0;$E0;$E0;$E0;$E0"$E21C";F.G=E21C TOG;F.[illegible]IN."CO
RRECTION "$E0;?G=?E80;P.$12;G=G-1;R.
150f@=0;P.$12$7"FATAL ERROR DETECTED ("?@")";P."PROGRAM IS ATTEMPTING TO T
IDY-UP AND TERMINATE";F.R=0 TO300;WAIT;N.;GOS.[illegible]P.$12;P."THE FOLLOWING OPERATI
ONS ARE OUTSTANDING "$(O+E21C);E.
```

```
160[illegible]P."t....TERMINATING";DOM=M+1;GOS.[illegible]IF?M=E80;?M=E20
170[illegible]M?2=EFF;M=J+1;G=0;H=0;DO[illegible]IFM?2=E80[illegible]G=G+1;E80[illegible]LI.L
180[illegible]E100[illegible]M[illegible]?M=EFF;R.
190IF.$12;?EE1=0;P."i....INITIALISING";G=0;DO IFM?2=E80 G=G+1
200[illegible]?M=EFF[illegible]G=0[illegible]?M=E100[illegible]G=G+1
210?M=0[illegible]?1=0[illegible]U.?M=EFF[illegible]GOS.[illegible]EFF000000[illegible]EFFFF
0000[illegible]IF[illegible]EFF5[illegible]EFFFF2E46 G.[illegible]
220[illegible]EFF0000FF;U.[illegible]EFF4F54FF[illegible]IF?M=E20[illegible]?M=E80
230T=0[illegible]EFFFF0000[illegible]EFFFF2E50[illegible]E50455453;T=1
240U.T OR?M=ED OR?M=E20;IFT IFM?-1=E20;M?-1=E80
250GOS.c
260[illegible]EFFFF0000[illegible]EFF000000[illegible]E10000[illegible]IF[illegible]E4549 IF[illegible]E2E41 IF[illegible]E524
F IF[illegible]EFF4[illegible]4541 G.9
270IF[illegible]ED IFM?-1=E20 M?-1=E80
280IF[illegible]EFF4[illegible]
290[illegible]
300[illegible]
310[illegible]M?2=EFF[illegible]
320nP."n....REMOVING 'NEXT' VARIABLE";GOS.[illegible]IF?E80<>EFFR.
330[illegible]DOT=0[illegible]GOS.[illegible]EFFFF0000[illegible]E54584542[illegible]IFM?4<>E20 IFM?4<>ED
M=M+4;T=1
340IF[illegible]EFFFF2E4E[illegible]IFM?-1<>E45[illegible]IFM?2<>E20[illegible]IFM?2<>ED[illegible]T=1
350IFT DO[illegible]E80=M[illegible]LI.L[illegible]U.?M=E20 OR?M=E30
360U.M?2=EFF;R.
370pP."p....REMOVING PARENTHESIS";GOS.[illegible]IF?E80<>EFFR.
380[illegible]E22[illegible]E282D2F3C[illegible]E3D3E5E7C[illegible]
OS.o[illegible]IF?M<>E28 G.[illegible]
390T=1[illegible]F.P=E60 TOE90[illegible]IFX?M=?P;T=0
400U.X?M=E29[illegible]N.[illegible]IFT[illegible]E80=M[illegible]LI.L[illegible]E80=X+M-1[illegible]LI.L
410N[illegible]U.M?2=EFF;R.
420sP."s....REMOVING SPACES";GOS.[illegible]IF?E80<>EFFR.
430[illegible]DOM=M+1;GOS.o;IF?M=E20[illegible]E80=M[illegible]LI.L[illegible]
440U.M?2=EFF;R.
450[illegible]P.$12"** LINE WRAP ROUTINE CALLED **"[illegible]P.$7[illegible]P."THIS ROUTI
NE SHOULD NOT BE USED";P."WITH PROGRAMMES THAT REFERENCE";P."LINE NUMBERS I
N GOTO/GOSUB AND";P."SIMILAR COMMANDS.";P."HOLD DOWN ANY KEY UNTIL THE BELL"
460P."SOUNDS TO SKIP THIS ROUTINE."
470T=0;DOT=T+1;LI.(L+E2A);WAIT;U.T=3400R?E80<>EFF;IF?E80<>EFF;?D=E62
480P.$7 R.
490wP."w....LINE WRAP";GOS.[illegible]IF?E80<>EFFR.
500[illegible]M=M+3
510[illegible]T=0;DO[illegible]EFF000000[illegible]EFF404552 OR[illegible]EFF444E45;T=1
520[illegible]EFFFF0000[illegible]EFFFF4649 OR[illegible]EFFFF2245;T=1
530[illegible]U.T OR?M=ED[illegible]IFT[illegible]
540IFM?1=EFF R.
550IFM?3[illegible]EFF R.[illegible]E7D[illegible]T=1
560IF[illegible]L.(M+1)[illegible]254;T=1
570IFT;N=M;G.v
580?M=E30;M=M+1[illegible]E80=M[illegible]LI.L[illegible]E80=M[illegible]LI.L;G.v
590rP."r....REMOVING REMARKS";GOS.[illegible]IF?E80<>EFFR.
600[illegible]DOM=M+1;GOS.o[illegible]EFF000000[illegible]EFF404552 G.d
610IFM?-1<>E20G.[illegible]
620D[illegible]E80=M[illegible]LI.L[illegible]M?-1<>E20
630[illegible]DOT=T+1[illegible]?M=E30 OR[illegible]IFM?-2=ED IFM?[illegible]=ED M=M-3;T=T-3;G.[illegible]
640IFM?-1=E30 IFM?[illegible]=ED M=M-1;T=T+1;G.[illegible]
650IFM?-1<EF IFM?-1<E70 IFM?[illegible]=ED;G.[illegible]
660T=T+1
670[illegible]F.I=1 TOT;[illegible]E80=M[illegible]LI.L;N.
680[illegible]U.M?2=EFF;R.
690cP."c....SHORT FORM COMMANDS";GOS.[illegible]IF?E80<>EFFR.
700[illegible]E20[illegible]E100[illegible]E20[illegible]D=S+L.S[illegible]
710[illegible]T=S[illegible]E100[illegible]U.?M=E20[illegible]?M=E20[illegible]M?1=E20[illegible]M?2=E20;P.$E0[illegible]LI.
EFE22;P."CHANGING "$E100;DOM=M+1;GOS.o;IF?M=E30;DOM=M+1;U.?M=E20
720IF?M=?S N=M;GOS.[illegible]S=T[illegible]
730U.M?2=EFF;S=[illegible]S+4;IF$S="STOP"P.[illegible]$E0;LI.EFE22;P.$E0;R.
740G.[illegible]
750[illegible]IF[illegible]R.
760[illegible]S=S+1;IF?S<>E20 G.[illegible]
770[illegible]S+1[illegible]E30[illegible]E80=M[illegible]LI.L[illegible]O=Q-1;U.O=0[illegible]S=S+2[illegible]DOT[illegible]S=S
+1;U.?S=ED[illegible]N=N-1;R.
780[illegible]G.b
790 PRINT,3,P.
800 INPUT,2,IN.
810 GOTO,2,G.
820 GOSUB,1,GOS.
830 END,1,E.
840 ABS,1,A.
850 AND,1,A.
860 DGET,2,D.
870 SPUT,2,S.
880 COUNT,3,C.
890 COS,1,C.
900 DEG,1,D.
910 NEXT,2,N.
920 FOR,1,F.
930 FLT,1,F.
940 HTN,1,H.
950 FOUT,1,FO.
960 SGET,2,S.
970 LEN,1,L.
980 LET,2.
990 LINK,1,LI.
1000 LIST,2,L.
1010 LOAD,1,LO.
1020 LOG,1,L.
1030 NEW,1,N.
1040 EXT,1,E.
1050 EXP,1,E.
1060 RAD,1,R.
1070 RETURN,4,R.
1080 RND,1,R.
1090 SAVE,1,SA.
1100 GET,1,G.
1110 SHUT,1,SH.
1120 SPUT,1,SP.
1130 STEP,2,S.
1140 TAN,1,T.
1150 THEN,[illegible]
1160 TOP,1,T.
1170 VAL,1,V.
1180 UNTIL,3,U.
1190 STOP
1200bR.[illegible]
```

version. For example Print is replaced by P.; Input by In.; FUntil by FU.; Gosub by GOS. etc. Over 40 commands are processed by this routine which also displays the command being changed.

The control variable in a For-Next loop need not be included in the Next command. The Next variable — N — routine removes all such variables from Next and N. commands.

The remove-parenthesis — P — routine removes sets of brackets which do not enclose one of the following:

!% &* + – < = > ? !|

Note that the list does not include the hash symbol. Leaving this out creates a problem only when assembler instructions of the following form are used:

STA (# 80),Y

The remarks routine — R — removes all Rem statements, whatever their form:

10 REM	All of this line will be removed
20|A|REM	The line number and label will be left
30 A = 3;REM	The statement A = 3 will be left.

The spaces routine — S — removes all remaining spaces within the program. Spaces necessary for correct interpretation are exchanged by the initialising routine for inverted blanks and are thus not affected by this routine.

The line-wrap routine — W — makes use of the fact that while the length of lines of Basic text in a program is normally limited by the size of the input buffer to 64 characters, the interpreter can handle lines of up to 254 characters. This routine generates lines of up to the maximum allowable length.

The routine checks for If, Rem and End commands in the preceding line, and for labels in the current line, and will not remove the line number if any of these are present.

You should note that, once this routine has been run, the Atom's Editor will be unable to change new program lines which are longer than 63 characters, so make sure your target program is thoroughly tested out after all other operations are complete, before you use this routine.

The terminating routine — T — completes the processing by removing all inverted |@| labels, replacing inverted blanks with spaces and renumbering the entire target program, taking account of my lines previously marked with inverted |@| markers. The following example indicates the numbering sequence used. First, before processing:

```
10 REM example
20 INPUT A;GOSUB |A|
30 IF A=3 GOTO 50
40 PRINT A;END
50|@|PRINT "A=3";END
60|A| RETURN
```

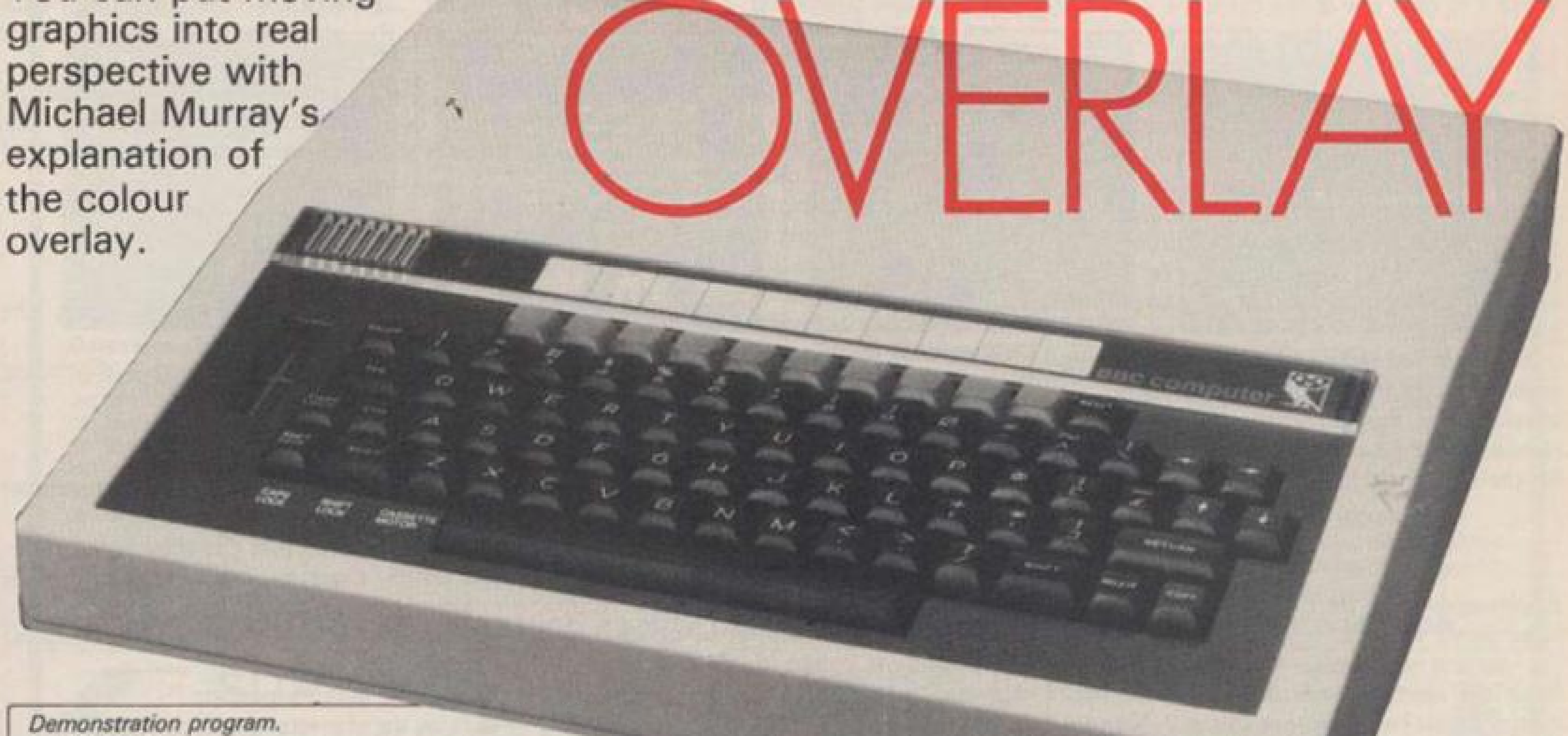
The vertical lines indicate inverted characters. After processing:

```
1IN.A;GOS.|A|;IFA=3 G.50
2P.A;E
50P."A=3";E.
51|A|R.
```

■

BBC COLOUR OVERLAY

You can put moving graphics into real perspective with Michael Murray's explanation of the colour overlay.



Demonstration program.

```
10MODE2
20VDU 5 :REM Join the text and graphics cursors
30VDU19,0,4,0,0,0 :REM Background (colour 0) = blue
40VDU19,1,5,0,0,0 :REM Far figure (colour 1) = magenta
50VDU19,2,3,0,0,0 :REM Near figure (colour 2) = yellow
60REM Near figure + far figure (colour 3) = yellow, so does not need to be re
-defined
70VDU19,4,7,0,0,0 :REM Foreground (colour 4) = white
80VDU19,5,7,0,0,0 :REM Foreground + far figure (colour 5) = white
90VDU19,6,7,0,0,0 :REM Foreground + near figure (colour 6) = white
100REM Foreground + far & near figures (colour 7) = white, so does not need to
be re-defined
110REM**** SET THE SCENE ******
120GCOL0,4 :REM Lines 110-140 draw the foreground
130MOVE 500,0
140DRAW 600,900
150PLOT85,700,0
160XN%=0 :REM Start position of the near figure
170 N%=8 :REM Increment to move near figure
180XF%=1279 :REM Start position of the far figure
190 F%=-16 :REM Increment to move far figure
200MOVE XN%,500 :REM Move to near figure start point
210VDU23,224,&FF,&FF,&FF,&FF,&FF,&FF,&FF,&FF :REM Re-define CHR$(224) as the n
ear figure, an oblong
220GCOL3,2:VDU224 :REM Print the near figure
230MOVE XF%,600 :REM Move to the far figure start point
240PROCTRIANGLE :REM Draw the far figure
250REM**** MAIN LOOP ******
260REPEAT
270PROCMOVENEAR :REM Move the near figure
280PROCMOVEFAR :REM Move the far figure
290UNTIL FALSE :REM Press ESCAPE to stop
300END
310DEF PROCTRIANGLE :REM Draw the far figure
320GCOL3,1 :REM EOR colour 1 (magenta)
330PLOT1,-200,0
340PLOT81,100,-300
350ENDPROC
360DEF PROCMOVENEAR :REM Move the near figure
370GCOL3,2 :REM EOR colour 2 (yellow)
380MOVE XN%,500 :REM Move to the current position
390XN%=XN%+N% :REM Calculate the new position
400VDU224 :REM Erase in the current position
410MOVE XN%,500 :REM Move to the new position
420VDU224 :REM Print in the new position
430IF XN%<4 OR XN%>1215 THEN N%=N%*(-1) :REM Change direction at the edge of t
he screen
440ENDPROC
450DEF PROCMOVEFAR :REM Move the far figure
460MOVE XF%,600 :REM Move to the current position
470XF%=XF%+F% :REM Calculate the new position
480PROCTRIANGLE :REM Erase from the current position
490MOVE XF%,600 :REM Move to the new position
500PROCTRIANGLE :REM Draw in the new position
510IF XF%>1271 OR XF%<208 THEN F%=F%*(-1) :REM Change direction at the edge of
the screen
520ENDPROC
```

THIS IS a detailed explanation of one of the easiest ways to obtain moving graphics with colour overlay.

The Exclusive Or method is based on putting colours on the screen so that they are Exclusive Ored — EOR — with the colour already there, that is, by using GCol3,—. In this case the logical colour number must be considered as a binary value, for example:

colour 0 = 0000
colour 1 = 0001
colour 2 = 0010
colour 3 = 0011
etc., to:
colour 15 = 1111

To Exclusive Or two binary numbers they must be compared bit by bit. If a bit in one number is 1 and the corresponding bit in the other is 0 then the result will be 1, otherwise if both corresponding bits are 0 or both are 1 the result will be 0. For example:

binary	decimal	binary	decimal
0011	3	1101	13
1010	10	0111	7
1001	9	1010	10

Thus colours 3 and 10 will produce colour 9; colours 13 and 7 will produce colour 10.

This principle may be extended to cover a combination of as many colours as required. For example:

1001 colour 9
1100 colour 12
1011 colour 11
0110 gives colour 6

(continued on next page)

Program 1.

```
10MODE5
20VDU5 :REM Join text and graphics cursors
30GCOL3,3 :REM EOR colour 3 with background
40X=0 :REM Set start position
50MOVE X,500
60PRINT"A"
70REPEAT
80PROCMOVE
90UNTIL X>1215 :REM Until the edge of the screen is reached
100END
110DEF PROCMOVE
120MOVE X,500 :REM Move to the current position of the character
130PRINT"A" :REM Erase the character in the current position
140X=X+8 :REM Calculate the new character position
150MOVE X,500 :REM Move to the new position
160PRINT"A" :REM Print the character in the new position
170ENDPROC
```

(continued from previous page)

Note that the answer shows which bits are set to 1 in only one of the colours.?

Program 1 shows how the EOR method moves the letter A across the screen.

Layering of colours is best explained by using an actual example, so consider the following problem: there are to be two figures which will appear on the background, one in the far distance which will be plotted, and one in the near distance which will be printed. The near figure must pass in front of the far figure, and both figures must pass behind a fixed foreground object.

As mentioned earlier it is convenient to use colour 0 for the background, so this will be our starting point. For no particular reason we will choose colour 1 for the far figure and colour 2 for the near figure, so we have:

background	0000	colour 0
far figure	0001	colour 1
near future	0010	colour 2

Applying the rules for EOR, if the two figures coincide we will get:

far and near figures	0011	colour 3

Since the near figure must appear in front, colour 3 must be the same as colour 2. Now let the foreground be colour 4 — another arbitrary choice — and consider what happens if either or both of the figures coincide with the colour selected for the foreground.

foreground	0100	colour 4
far figure and foreground	0101	colour 5
near figure and foreground	0110	colour 6
both figures and foreground	0111	colour 7

Since the foreground colour must always be the one to show, colours 4, 5, 6 and 7 must all be the same as the foreground colour.

We now have four different layers of colour and still have eight more colours that we can use — in mode 2. Note that as the figures are defined so far only four different colours will be displayed, although we have used a total of eight to obtain the layered effect.

The reason for using EOR is that applying a colour using EOR has an on/off effect. If a character is Printed or Plotted using EOR it will appear on the screen, but if it is Printed/Plotted again in the same place it will disappear.

Example:	background	— colour 6	0110
	character	— colour 3	0011
	result	— colour 5	0101

Thus printing a character in colour 3 on a background of colour 6 will result in the character appearing as colour 5. Now if the same character is printed again in the same place using the original colour 3, the following happens:

displayed character	— colour 5	0101
re-print character	— colour 3	0011
result = background	— colour 6	0110

This demonstrates that printing once displays the character, and printing twice restores the background.

It is usually beneficial to use colour 0 as the main background colour since it will not change the colour of anything Exclusive Ored on to it. For example:

0000	0000
1111	0101
1111	0101

Movement is simply achieved using the following general procedures:

- Join the text/graphics cursors — if printing rather than plotting.
- Move to the start point.
- Print the character.

This gives a starting point and movement can be obtained by:

- Move to the current character position.
- Print the character, i.e., erase that which is already there.
- Calculate the required new character position.
- Move to the new position.
- Print the character at the new position.

The routine in lines 4 to 8 may be written as a procedure and called to move the character whenever needed. ■

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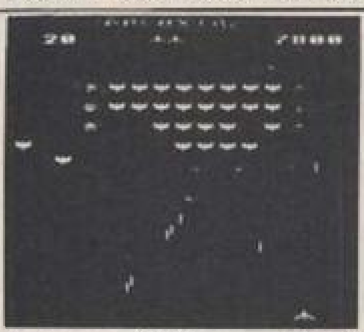
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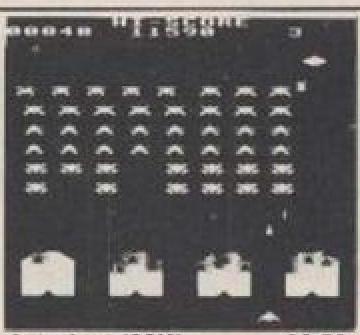
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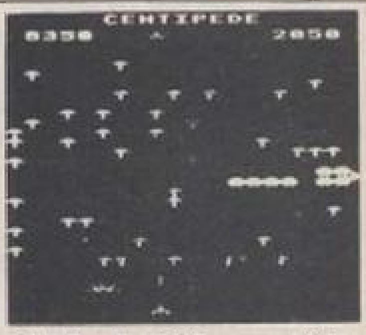
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BBC A LA MODE

If you have ever wondered how Munchymen, Space Invaders and their ilk make it on to the small screen Fintan Culwin lifts the veil of mystery surrounding their genesis. Discover how to conjure up similar effects on mode 5 screens.

IF YOU HAVE seen the advertising leaflets, or even been lucky enough to see the games produced by companies like Acornsoft, you will probably have been impressed at the quality of the multicoloured figures used in the graphics. Just as impressive is the speed with which the figures are plotted on to and off the screen.

The most obvious way to reproduce these figures would be to use a combination of Plot and GCol commands. Plot commands in the range 64-71 will allow plotting of single pixels. The GCol commands enable changing of the Plotted colour.

Even with the speed of BBC Basic this method is not fast enough for games applications and consumes a prodigious amount of memory, even for a small figure. The use of assembly routines to do the equivalent, passing the commands and values to the machine-operating system — MOS — via the Oswrch routine does not significantly increase the speed, although it consumes less memory. This is not a failing of the assembler, but a reflection of the efficiency of the Basic interpreter which also uses Oswrch.

An alternative solution to the problem is to use the user-definable characters. By carefully designing pairs of these characters and by using 'Or' plotting, all four colours can be produced on the screen within the confines of a single-character cell.

The best way of passing all this information to the screen is to assemble a string containing both the characters to be plotted and the control characters — see *User Guide* page 377. An example of this is given in listing 1.

The listing creates four user-defined characters which are Ored together on the screen to give the three displayed colours. The first two characters are plotted onto the screen in colour 1. The second two characters are overlayed on top of the first two in colour 2. By Oring colour 2 on top of colour 1, any pixels that are turned on in both colours are displayed in colour 3. All of this information is contained in the S string which can be interpreted as

GCOL 0 1, PRINT CHRS(225) CHRS(225) : backspace : backspace : GCOL 1 2 : PRINT CHRS(226);(227)

The D string is similar using character 255 to overprint the figure in the background colour.

This again uses vast amounts of memory and is limited to the speed of Basic, or, via Oswrch, the MOS. It has the added disadvantage that there is no easy way of realistically exploding or assembling the figure out of hyperspace.

The one advantage of both these methods is that they will work on the other side of the Tube — when the second processor becomes widely available.

I will now show two ways of controlling screen memory directly to produce a figure identical to that produced by listing 1. I will only be describing how to use mode 5 although similar considerations apply to other multicoloured modes.

In order to understand how to control screen memory directly, it is necessary to investigate the way the colour information is coded. The mode 5 screen has a resolution of 160 by 256 pixels, controlled by a 10K block of memory from &5800 in a 32K machine, &1800 in a 16K machine. Simple arithmetic shows that each byte controls four pixels. These are arranged from Himem upwards as blocks of eight bytes controlling what would be a character cell of a 40 by 32 character screen. The first eight bytes control the character cell in the top left-hand corner; the next eight, the cell beside it — and so on.

As each byte controls four pixels, all four pixels have to be accounted for when deciding which value to set the byte to. Each pixel has an ordinal value and a colour scaling value.

(continued on page 95)

```
 99 REM LISTING1
100 PROCINITIALISE
110 MODE5
120 VDU 19,2,4,0,0,0
130 VDU5
140 FOR X%=0 TO 1216
STEP 32
150 MOVE X%,640:PRINT
T$;
160 FORN=0TO30:NEXT
170 PRINTD$
180 NEXT
190 GOTO 140
1000 DEFPROCINITIALISE
1010 VDU23,224,&80,&C0,
&E0,&70,&7A,&05,&02,&05
1020 VDU23,225,&00,&00,
&00,&00,&AC,&5E,&AF,&5E
1030 VDU23,226,&00,&00,
&00,&00,&05,&3A,&3D,&1A
1040 VDU23,227,&00,&00,
&00,&00,&5C,&AE,&5F,&AE
1050 VDU23,255,&FF,&FF,
&FF,&FF,&FF,&FF,&FF,&FF
1060 T$=CHR$(18)+CHR$(0)
+CHR$(1)+CHR$(224)+CHR$
(225)+CHR$(8)+CHR$(8)+
CHR$(18)+CHR$(1)+CHR$
(2)+CHR$(226)+CHR$(227)
1070 D$=CHR$(8)+CHR$(8)
+CHR$(18)+CHR$(0)+CHR$
(0)+CHR$(255)+CHR$(255)
1080 ENDPROC
```

Listing 1.

```
100 MODE5
110 VDU 19,2,4,0,0,0
120 FOR X%=&5E40 TO &5F40 STEP 8
130     !X%=&070E0C08:!(X%+4)=&10303007
140     !(X%+8)=0:!(X%+12)=&A5D2A55A
150     !(X%+16)=0:!(X%+20)=&A55AA55A
160    !(X%+24)=0:!(X%+28)=&EEFFEECC
170    FOR N=0 TO 100:NEXT
180   FORD%=0 TO 28 STEP 4
190     !(X%+D%)=0
200       NEXT:NEXT
210 GOTO 120
```

Listing 2.

(continued from page 93)

This is my own terminology to avoid confusion with the user guide. The ordinal values of the pixels are, from left to right, 8,4,2,1. The colour-scaling values are 0 for logical colour 0, 1 for logical colour 1, 16 for colour 3 and 17 for colour 3.

Each pixel is set by multiplying its ordinal value by the chosen colour-scaling value. The results of all four pixels are added together to give a number in the range 0 to 255 which when sent to the screen will give the required result.

Two examples should make this a little clearer. Suppose we want to switch on the four pixels in the colour sequence 3,2,1,0 ; the calculation is

$(8 \times 17) + (4 \times 16) + (2 \times 1) + (1 \times 0) = 202$

or the converse sequence 0,1,2,3

$(8 \times 0) + (4 \times 1) + (2 \times 16) + (1 \times 17) = 37$

```
100  PROCASSEMBLE
110  MODE5
120  VDU 19,2,4,0,0,0
130  REM
140  CALL pass
150  GOTO 140
250 DEFPROCASSEMBLE
260  DIM D% 35
270 DIM T% 255
280  FOR U%=D% TO D%+28
     STEP 4
290    READ V%:!U%=V%:NEXT
300 FOR opt =0 TO 2 STEP 2
310    P%=T%
320   [OPT opt
330    .pass LDA £&40
340   STA &70
350   LDA £&5E
360   STA &71
370    LDA £&1E
380   STA &72
390    .move JSR plane
400   JSR del
410   JSR clear
420   JSR inc
430   DEC &72
440     BNE move
450    RTS
460    .plane LDY £&1F
470    .bit LDA D%,Y
480    STA (&70),Y
490    DEY
500    BPL bit
510    RTS
520   .clear LDY £&1F
530   .biu LDA £0
540   STA (&70),Y
550   DEY
560   BPL biu
570   RTS
580    .inc CLC
590   CLD
600   LDA &70
610   ADC £8
620   STA &70
630   LDA &71
640   ADC £0
650   STA &71
660   RTS
670   .del LDX £&8F
680   .loop1 NOP
690   LDY £&FF
700     .loop2 DEY
710   BNE loop2
720   DEX
730   BNE loop1
740   RTS
750   ]
760     NEXT
770  ENDPROC
850  DATA &070E0C08,
     &10303007
860  DATA 0,&A5D2A55A
870  DATA 0,&A55AA55A
880  DATA 0,&EEFFEECC
```

Listing 3.

To verify this, put your machine into mode 5 and Poke locatioms &5E80 and &5E90 with the calculated values. There remain the problems of defining the figure on a grid, calculating the values and sending these values to the screen.

Listing 2 uses the Basic indirection operator "!" — Pling. This is similar to the Poke operator which sets one byte of memory; Pling sets four sequential bytes.

The way that Pling works is initially confusing. If the four bytes that you wish to set are — not hex — A1 B2 C3 P4, then the number that should be Plinged is — in hex — &D4C3B2A1. If you stick to hex then apart from the value of zero, there are always eight digits in the number to be Plinged.

Listing 3 gives the same figure, but this time the data is sent to screen memory via a machine-code routine. I will not explain the way the machine code does this, but will just give the relative timings it takes for each of the routines to send the figure across the screen one hundred times:

LISTING 1	388secs
LISTING 2	65secs
LISTING 3	1.6secs

The other disadvantage of addressing screen memory directly should now be obvious. The codes as presented will only produce figures in the defined character positions, not as the first two methods will allow at any place on the screen. I do not think that for most uses this is a significant restriction. The advantage that these methods do have is that the figures can be assembled or exploded in a most spectacular manner. ■



MEMOPAK 16K For those just setting out on the road to real computing, this pack transforms the ZX81 from a toy to a powerful computer. Data storage, extended programming and complex displays become feasible.
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MEMOTECH

The Memotech approach to microcomputing is to take the well-proven and popular ZX81 as the heart of a modular system. This small computer houses the powerful Z80A processing unit and acts as the central processor module through which the MEMOPAKS operate.

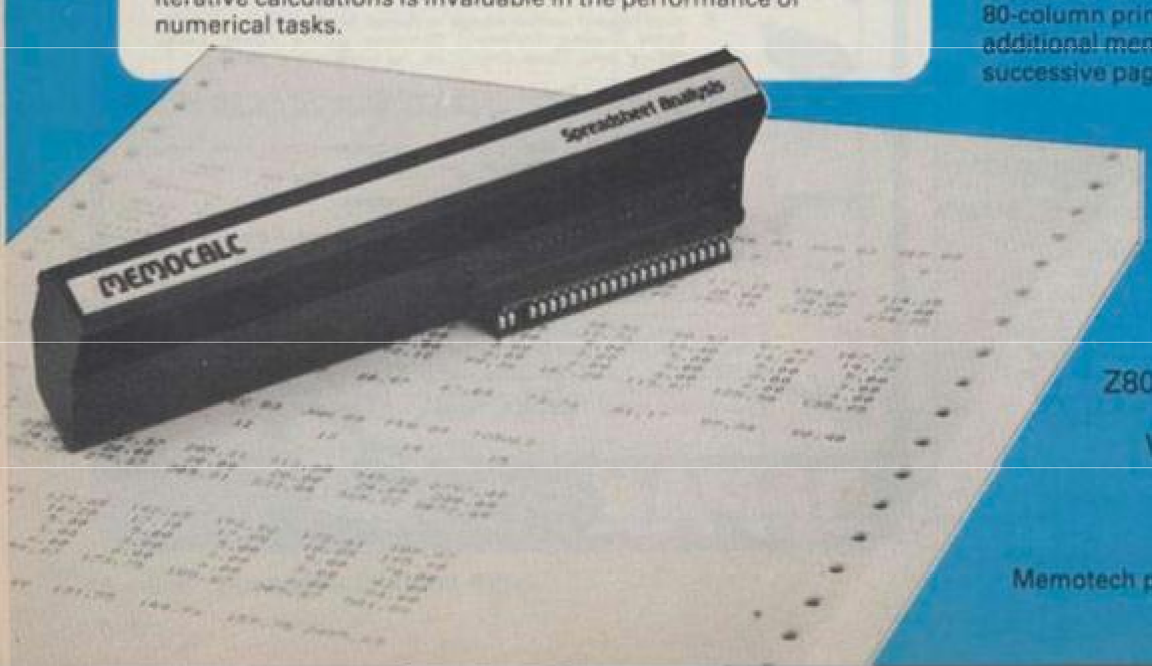
Memotech has a reputation for professional quality, producing units which are designed to fit perfectly, to look well-balanced, and to work efficiently and reliably.

The modular approach gives ZX81 owners the freedom to design the system they really need. Furthermore, the intercompatibility of the modules ensures that later additions will click straight in, to give you a system that grows with your ambitions and abilities.

As one example, a system with 16K of memory and MEMOCALC is all that is required to perform sophisticated numerical calculations giving the same results as a computer at 10 times the price. The problem may be as complicated as a cash flow or production schedule, or as simple as household accounts or pocket money budgeting. If the bank manager wants to see the cash flow, then a single print instruction to the Centronics I/F will give a printout which is more than acceptable to any bank.

The example system which is shown, on the other hand, would satisfy the needs of someone who wanted to enter data via a light-touch keyboard, construct and label graphs, and then copy the screen to an 80-column printer. Only 16K of memory is used here but with additional memory, more than one video page can be stored. Up to 7 successive pages can be displayed cyclicly to give animated displays.

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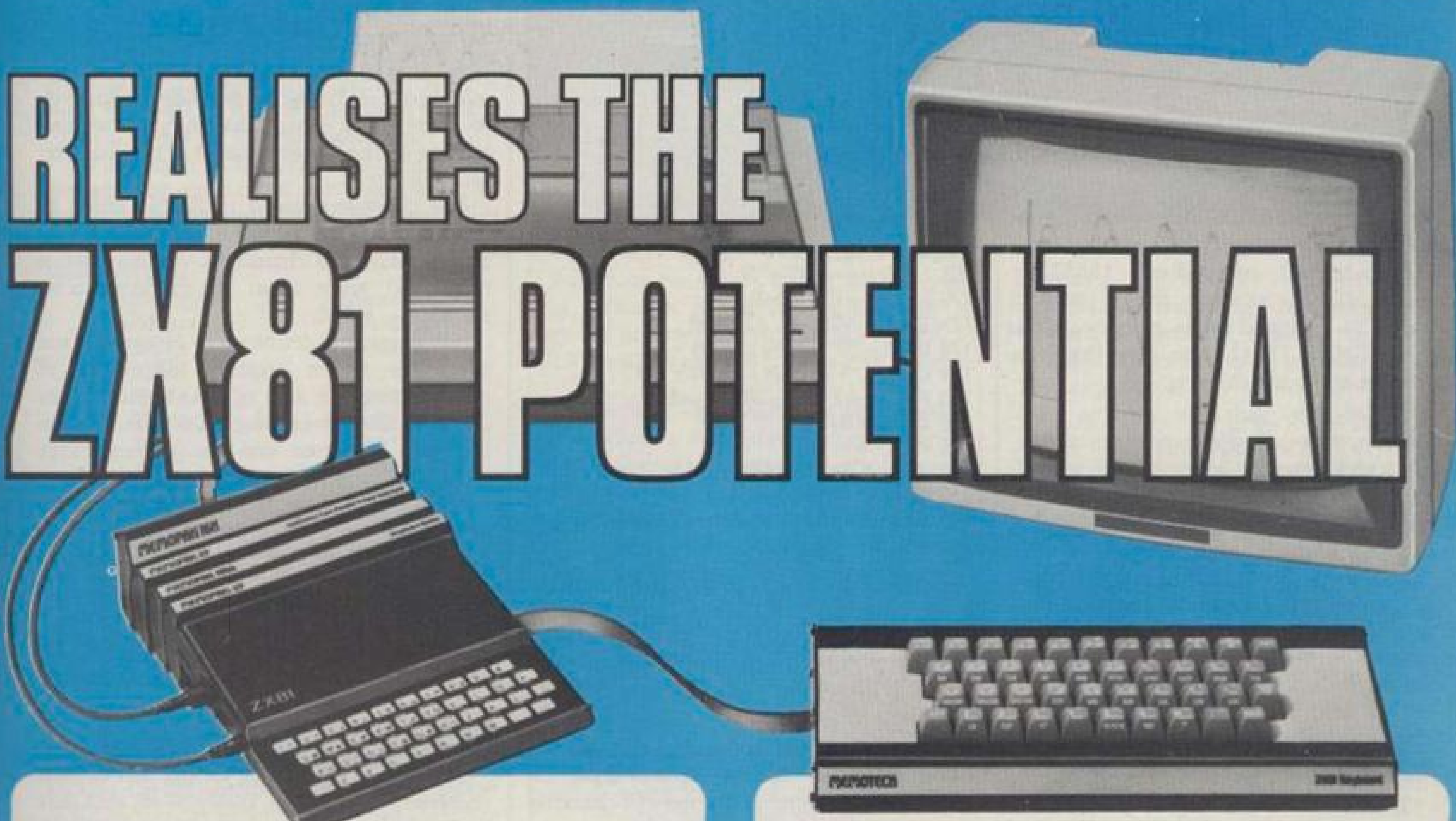




MEMOPAK HRG This pack breaks down the constraints imposed by operating at the ZX81 character level and allows high definition displays to be generated. All 248 × 192 individual pixels can be controlled using simple commands, and the built in software enables the user to work interactively at the dot, line, character, block and page levels. Scrolling, flashing and animation are all here.

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REALISES THE ZX81 POTENTIAL



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A) Memories are cumulative e.g. 16K and 32K can be added to the MEMOPAK 16K or even to the Sinclair 16K RAM pack.

B) The HRG firmware allows commonly used constructions (such as scrolling, shading and labelling graphs), which might otherwise be beyond the user's programming capabilities, to be evoked by a few simple commands.

C) The Centronics I/F converts ZX81 character codes into ASCII and extends the print line to the width of the printer, still using the LLIST, LPRINT and COPY commands.

Looking forward, Memotech will continue to back the ZX81 through 1983 with fast storage devices, pressure sensitive electronic drawing boards and more software packs including a wordprocessor and an RS232 interface.

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ZX CHARA

A DISPLAY of the character set of the ZX Spectrum obtained using the three lines of Basic

```
10 FOR x=255 TO 32 STEP -1
15 PRINT CHR$ x;
25 NEXT x
```

is shown in figure 1. From the character set summary in the Sinclair manual it may be noted that each character is assigned a unique code in the range 0 to 255. However some codes are not used, and others are used as control characters. There are only 224 characters that can be displayed on the screen, — codes 32 to 255 inclusive — see range of x values in line 10 of the program.

The characters having codes in the range 32 to 127 inclusive, are stored in a block of read only memory — ROM — between memory addresses 15616 to 16383 inclusive. Each character is defined by the contents of eight successive memory bytes.

The space character — code 32 — is stored in the eight bytes in the address range 15616 to 15623, and successive codes are correspondingly stored in successive blocks of eight bytes. The eight bytes of any of these characters are stored in memory ranging from address 15616 + (8*(code-32)) to address 15632 + (8*(code-32)). For example, the + character — code 43 — is stored in the memory address range 15704 to 15711. You may Peek into these memory locations using

```
10 FOR x=0 to 7
15 PRINT PEEK (15704+x)
20 NEXT x
25 STOP
```

to obtain a display of the contents of each memory location. The values are

Memory address	Displayed contents decimal	Memory contents binary
15704	0	00000000
15705	0	00000000
15706	8	00001000
15707	8	00001000
15708	62	00111110
15709	8	00001000
15710	8	00001000
15711	0	00000000

When the ZX Spectrum displays this + character it interprets the bit pattern such that 0 is paper and 1 in ink, and it is displayed using an eight-by-eight picture-element — pixel — grid, as shown in figure 2.

Program 1 listed below may be used to display, for an inputted character code, the eight-by-eight bit character definition and the pixel grid definition boosted by a factor of 64.

```
  2 BORDER 4
  4 PAPER 6
  5 INPUT code
 12 PRINT AT 5,6; "The character is ";CHR$
    code
 25 FOR x=1 TO 8
 30 LET j=15615+8*(code -32) +x
 32 LET g=PEEK j
 40 GO SUB 150
 50 NEXT x
150 FOR n=1 TO 8
155 LET y=g/2
165 LET r=g-(INT y*2)
175 LET a$=CHR$ (48+r)
177 PRINT AT 7+x, 12-n;a$
178 IF a$="0" THEN LET a$=" "
179 IF a$="1" THEN LET a$="■"
180 PRINT AT 7+x, 28 - n;a$
185 LET g=INT y
195 NEXT n
200 IF x=8 THEN PAPER 4
210 IF x=8 THEN STOP
225 RETURN
```

Program 1.

Character codes used with program 1 must be in the range 32 to 127. For example, when code 127 is inputted, the eight-by-eight binary bit pattern and corresponding eight-by-eight pixel grid definition, magnified by a factor of 64, for the © character is displayed, figure 3.

Program 1 may be modified so that you can obtain a display of the eight-by-eight bit pattern and pixel-grid definition of a character entered via the keyboard. In this case the keyboard-entered character is converted to the corresponding code using the Inkey$ function. To do this you must change lines 5, 12 and 30 to

```
 5 IF INKEY$="" THEN GO TO 5
12 PRINT AT 5,6; "The character is "; Z$
30 LET j=15615+8*(CODE Z$-32)+X
```

and insert the additional lines of program

```
 3 PAUSE 10
10 LET Z$=INKEY$
```

With the modified form of the program you cannot input all the characters with codes in the range 32 to 127 inclusive. For example the } character — code 125 — is excluded. But the modified form of the program does allow you to enter most characters directly without looking up the character codes in the character set summary.

The characters stored in ROM cannot be changed, and therefore if you require to display additional characters, you may define them and store them in random access memory — RAM.

It is possible to define up to 21 user-defined characters which require 168 bytes of memory, and the area of RAM reserved for them has the address range 32600 to 32767 in the 16K Spectrum and the address range 65368 to 65535 in the 48K Spectrum.

The address of the first byte in memory of any of the user-defined graphic in characters may be determined by using the Usr function in the form

```
PRINT USR "user defined graphic symbol"
```

and the computer outputs to the screen the appropriate address. For example

```
PRINT USR "D"
```

outputs the address 32624 for the 16K Spectrum, and 65392 for the 48K Spectrum.

The area of RAM used for the user-defined characters is initialised, at switch-on, with data bytes which define the alphabetic characters A

Figure 2.

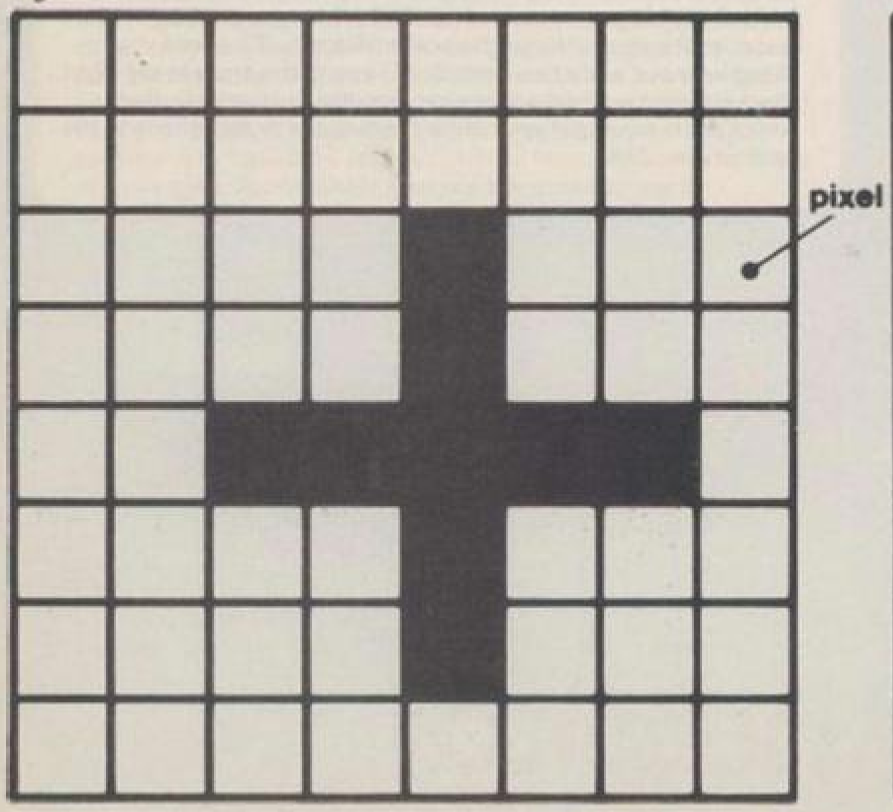
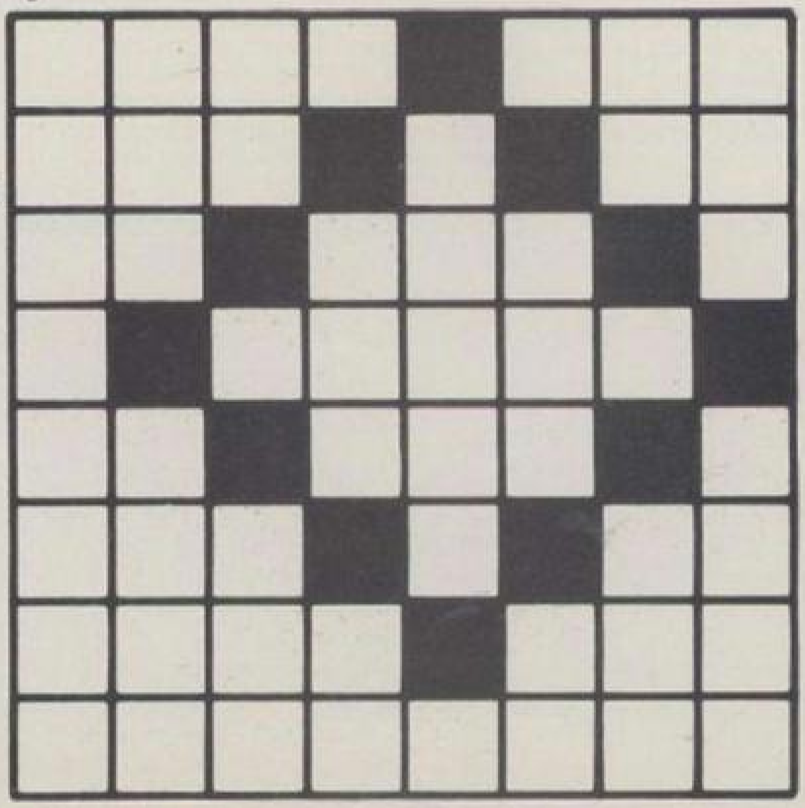


Figure 3.



ACTERS

Trevor Terrell and Robert Simpson provide character forming advice to help Spectrum users define their own graphics.

to U. The eight bytes of any of these characters are stored in the memory from address Addr+8*(code−144) to address Addr+7+8*(code−144), where code has a value in the range 144 to 164 corresponding to user-defined characters A to U respectively, as given in the character set summary. Addr is equal to 32600 for the 16K Spectrum and it is equal to 65368 for the 48K Spectrum.

For example, in the 16K Spectrum, if you examine the content of the eight bytes of memory with addresses from 32672 to 32679 inclusive, you will see that the J character in binary form as

Memory address	Memory contents
32672	00000000
32673	00000010
32674	00000010
32675	00000010
32676	01000010
32677	01000010
32678	00111100
32679	00000000

A simple way of proving this to yourself is to run Program 1 with line 30 changed to

```
30 LET j=32599+8*(code-144)+x 16K
```

or

```
30 LET j=65367+8*(code-144)+x 48K
```

shown in figure 3 you must first define the bit probably be of very little use to you because the same characters, A to U, exist as part of the character set stored in ROM. However, because the user-defined characters are stored in RAM you can generate your own character by writing the appropriate eight bytes into any of the 21 user-defined graphics memory areas. For example, to obtain a character of the form shown in figure 3 you must first define the bit pattern of each byte of the character. In this example we have

```
00001000
00010100
00100010
01000001
00100010
00010100
00001000
00000000
```

Let us assume that this character is to be identified as the user-defined character D, then we must store the above bytes in memory addresses Addr to Addr+7, where Addr is equal to 32624 for the 16K Spectrum and it is equal to 65392 for the 48K Spectrum. We can do this using

```
POKE Addr  , BIN 00001000
POKE Addr+1, BIN 00010100
  |      |      |      |
  |      |      |      |
  |      |      |      |
POKE Addr+7, BIN 00000000
```

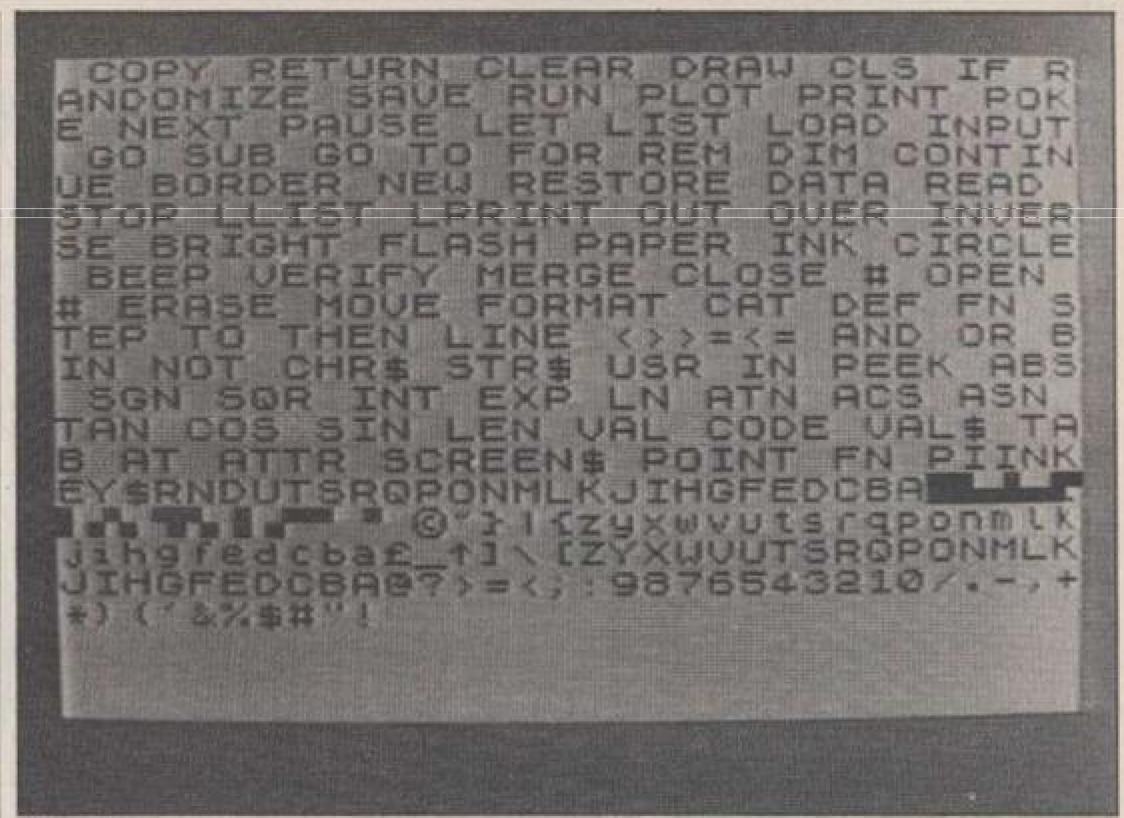


Figure 1.

To examine the binary bit pattern and pixel-grid definition of this defined character we may use program 1 with line 30 changed to

```
30 LET j=32599+8*(code-144)+x 16K Spectrum
```

or

```
30 LET j=65367+8*(code-144)+x 48K Spectrum
```

To include a user-defined graphic character in a Basic program you enter graphics mode and access the character by pressing the appropriate alphabetic symbol key A to U. For the above example to display the diamond character at the centre of the screen you enter

```
PRINT AT 10,15; "◇"
```

Where ◇ is obtained by putting the computer in graphics mode and pressing the D key. This character is used in the simple game shown in program 2, in which treasure has been randomly and invisibly buried in one character square of the screen display. The treasure is found by moving the character upwards or downwards by pressing the u or d key respectively, and left or right by pressing the L or R key, until the ◇ character is on the character square where the treasure has been buried. The number of moves taken to find the treasure is then displayed.

The eight-by-eight pixel grid pattern enables 2↑8↑8 (1.8446744E+19) different characters to be defined, however you can only have 21 user-defined characters. To create more characters you can use the Over 1 statement, which permits one character to overlay another character, but note that coincident inked pixels are written as Paper. ■

Program 2.

```
16K Spectrum
1 POKE 32624, BIN 00001000
2 POKE 32625, BIN 00010100
3 POKE 32626, BIN 00100010
4 POKE 32627, BIN 01000001
5 POKE 32628, BIN 00100010
6 POKE 32629, BIN 00010100
7 POKE 32630, BIN 00001000
8 POKE 32631, BIN 00000000
or
48K Spectrum
1 POKE 65392, BIN 00001000
2 POKE 65393, BIN 00010100
3 POKE 65394, BIN 00100010
4 POKE 65395, BIN 01000001
5 POKE 65396, BIN 00100010
6 POKE 65397, BIN 00010100
7 POKE 65398, BIN 00001000
8 POKE 65399, BIN 00000000
10 BORDER 5: PAPER 6: INK 0:
FLASH 0
12 LET n=0
14 CLS
25 LET r=INT (RND*20)
35 LET c=INT (RND*31)
45 LET x=INT (RND*20)
55 LET y=INT (RND*31)
60 IF x=r AND y=c THEN GO TO 45
65 PRINT AT x,y;"◇"
85 LET k$=INKEY$
90 IF k$="" THEN GO TO 85
91 IF NOT (k$="u" OR k$="d" OR
k$="l" OR k$="r") THEN GO TO 85
92 IF INKEY$<>"" THEN GO TO 92
93 PRINT AT x,y;" "
95 IF k$="u" THEN LET x=x-1
115 IF x<0 THEN LET x=0
125 IF k$="d" THEN LET x=x+1
135 IF x>20 THEN LET x=20
145 IF k$="l" THEN LET y=y-1
155 IF y<0 THEN LET y=0
165 IF k$="r" THEN LET y=y+1
175 IF y>31 THEN LET y=31
225 PRINT AT x,y; "◇"
235 IF x=r AND y=c THEN GO TO 350
240 LET n=n+1
250 PRINT AT 21,0; "Number of Moves
= ";n
260 GO TO 85
350 FOR g=10 TO 0 STEP -1
355 BEEP .1,g
365 NEXT g
370 FLASH 1: PAPER 4
375 CLS : PRINT AT 10,10;"WELL
DONE"
385 PRINT AT 12,3; "Treasure Found In
";n;" Moves"
390 PRINT AT 16,4; "Press Key G TO
Go Again"
400 PRINT AT 18,4; "Or Press Key S To
Stop"
420 IF NOT (INKEY$="G" OR
INKEY$="S") THEN GO TO 420
425 IF INKEY$="G" THEN GO TO 10
430 IF INKEY$="S" THEN STOP
```

FULL ZX-81 CHESS

Figure 3. Rem display.

```
4 REM              DISPLAY

17207              LD HL NN    33 67 67        (17219)
                   LD DE NN    17 0  72        (18432)
                   LD BC NN    1 205 0
                   LDIR        237 176
                   RET         201
17219    18432     128 8 169 183 173 118
                   29 8 55 51 39 48 54 39 51 55 118
17236              30 8 53 53 53 53 53 53 53 53 118
                   31 8 0 128 0 128 0 128 0 128 118
17258              32 8 128 0 128 0 128 0 128 0 118
                   33 8 0 128 0 128 0 128 0 128 118
17280              34 8 128 0 128 0 128 0 128 0 118
                   35 8 181 181 181 181 181 181 181
                   181 118
17302              36 8 183 179 167 176 182 167 179
                   183 118
                   8 8 45 44 43 42 41 40 39 38 118
17324              8 8 8 8 8
17329    18542     LD BC NN    1 0 4
                   CALL NN     205 245 8       (2293)
                   LD HL NN    33 0 72
                   LD B N      6 110
                   PUSH BC     197
                   PUSH HL     229
                   LD A (HL)   126
                   RST 16      215
                   POP HL      225
                   POP BC      193
                   INC HL      35
                   DJNZ        16 247
17349    18562

                   LD HL NN    33 125 64       16509
                   LD (NN) HL  34 41 64        16425
                   JP NN       195 7 3
```




Figure 4. Code map. See also page 102.

```
ALIST
17037    LD HL NN     33 70 64
(141)    INC (HL)     52
( 66)    LD A (HL)    126
         ADD L        133
         LD L A       111
         LD (HL) C    113
         RET          201
CHGMV
17143    LD HL NN     33 55 67
(247)    LD A (HL)    126
( 66)    ADD N        198 128
         LD(HL) A     119
         RET          201
PMOVE
17151    LD HL (NN)   42 7 64
(255)    LD A (DE)    26
( 66)    LD C A       79
         LD A (HL)    126
         LD(HL) N     54 0
         LD(DE) A     18
         LD B A       71
         RET          201
```

IF YOU HAVE followed the series of articles to date, you should have managed to produce a game which consisted of a chessboard and logic which restricts the possible moves to only those that are legal, providing two-player chess.

Examining the memory map of the game you may have noticed that a significant proportion of the code is used in creating the board, which is big by ZX-81 1K display standards. If some way could be found to use the display file saved on tape and a minimal file "to boot", then we would have enough space to write a short computer playing routine.

One further point should be explained. It is not possible to give a good opening or finish to the game because that would require slightly more code than we have available in the 1K game. We actually have only 672 bytes.

The game, therefore, starts off with the computer playing white and either the King's pawn or the Queen's pawn moved forward one position. The following describes the machine code and techniques used in the creation of my 1K ZX-81 chess program. In order to produce the code you will require a machine with at least 3K of memory. The code has been created using a 3K machine, there should be no problems using 16K if the procedures given are followed and RAMtop is lowered to 1K before loading from tape.

First the Basic program consists of:

Line	Function
1	A Rem statement. From address 16514 to 17186
2	A Slow statement. This has been called from Basic to ensure that all ZX-81s will work irrespective of whether you have an early ROM with error or not.
3	A Rand Usr statement. To call the machine-code routine.
4	A Rem statement. From address 17207 to 17362 to create the display and move itself above RAMtop.
10	onwards. Your favourite machine-code loader or this one.

```
10 FOR A = 16514 to 18000
11 SCROLL
12 PRINT A; TAB 8;
13 INPUT B
14 POKEA, B
15 PRINT PEEK A
NEXT A.
```

To explain the logic of 1-4 above, assume you have entered the machine code in Rems 1 and 4. Delete all Basic lines except 1 to 4 inclusive. Now lower RAMtop by typing:

```
POKE 16389,72
PRINT USR 1040
```

IN 1K

In the last part of this series, David Horne creates a new game by making enough space for a playing routine.



Figure 1. Basic program listing.

```
   1 REM FAST VAL LN ▀"???=C RUN
 LN ▀▘E( IF AT / SCROLL AT LPRIN
T ?TAN " 1▀LN ▙RNDF:ALN ▙RND?▀▟(
CLEAR LEN ?F▀??A? C=▖ RETURN
A255 5"▀C ▚" ??TAN " " COPY PRINT
PLOT POKE £=▌ NEXT + FOR : DIM R
UN = "=£QRBNP▀M?RND? "▗▀S SCROLL
RND RETURN NC-I TO RETURN KC(? R
ETURN QC"▞ RETURN BC▌I STOP RET
URN B"""?▚ PRINT FAST VAL RETURN
Z52 RETURN ▀K,LN ▀RND RETURN "K<
 PRINT LN ▀PI LET RETURN C"AT L
PRINT ? RETURN "C▌ LET / AND AT
LPRINT LET ?(PEEK TAN 4"I LET -▀
?▚ FAST PRINT RETURN Z54 RETURN
▀K0LN ▀RND RETURN C0 RETURN "4)
? RETURN "4£LN ▀PI? RETURN ?5< R
ETURN +4ABS TAN ? RETURN "CODE ▀
PI/ LET LET LPRINT ?/VAL FAST VA
L STR$ FAST VAL ?5RNDRNDLN ▀▘LN
=??▀? LET LN "? LPRINT LN /?K"▀?
 LPRINT SGN ?? FAST STR$ LN /?K"
▌ PRINT LN RUN PILN "PIAT K▚▖SG
N LPRINT ? LPRINT LN IF PILN /?K
"▌LN IF PILN RUN PI?5URND? FOR 5
INKEY$RND▀▖▗"▌ /"5?RND)?RND"0 5"
 FOR GOSUB ▀TAN UR?LEN K5Y?? GOS
UB ▀"6▀RND▖"?5Y?? FAST VAL ?LN ▀R
ND RETURN 4;LN RUN PI?LN RUN RN
DLN RUN PILN ▙PIC"▀▀RND▀4 PRINT
AT LPRINT RTAN AT LPRINT (▗▀▀TAN
▗▚Y▀5▀???( UNPLOT LN ▀RND RETUR
N▚4 INPUT 6▀RND?LN RUN RNDS▀?LN
 ▀RND RETURN " FOR K>=LN ▙PICNOT
 ▀4 SAVE LN COPY PI OR LN "PI OR
 3▀LN FOR PILN ▀PI/TAB ??>/ RAND
 5?RNDPTAN 5?RNDOMINKEY$RND▙?5Y?
? FAST VAL ?LN ▀RND RETURN ▙4D?6
▛RNDLN RUN RNDLN ▙PIC1?-?LN COPY
 PI OR ▀LN PAUSE INKEY$LN "PI OR
 ??>5▀LN ▀INKEY$RLN PAUSE INKEY$
/ THEN AT LPRINT (COS UINKEY$RND
 RETURN C RETURN 5?RND>F??AC5 ?
0 C "0▀LN RUN PITAN 5R?▛RND,? NEW
 ▀5 PAUSE RND▗▀▀COS ?( CLS ?TAN
? OR M▀RNDLN (PI OR ?TAN
   2 SLOW
   3 RAND USR X
   4 REM 5??) ?"LN  GOSUB ▀TAN ▀
▀▀▀▀
7432 BKQBNR
7688 PP PPP
7944 ▀ P ▀
8200 ▀▀▀▀
8456 ▀▀▀▀
8712 ▀▀▀▀
8968 PPPPPP
9224 BKQBNR
3056 FEDCBA
2056 ▀" ▗LN PRINT ▀5 ?"?VAL FAST
 RUN 5?RND6DRND?▛▀LN ?"YA"=:LN (
?$ RETURN I4 SAVE Y1"£ LN (?▖ RE
TURN 94 SAVE /▀▀▀▀▀▀"▀"LN PRINT
 ▀)▀?"▗ LN ?"LN ,?5?RND6DRND?▛▜
▀   TO 15000
```

Figure 2. Machine-code listing.

```
16514        < 64   130 >
229 197 205 187   2  68  77  85
 20  40 247 205 189   7 126 193
197 165  40   6  12  16 250 193
 24 231 193 225 119 201   1  29
  8 205 130  64  43  14  38 205
130  64  35 126 214  28  71  14
 11 175 129  16 253 198  97  43
150  79 105  38  67 126   6   1
230 127 254   0  40  20   4 254
118  40  15 254  39  56  11 126
  4  46  55 134 203 127  40   2
  6   0 120 105 201   1  11 255
245 246 244  12
16614        < 64   230 >
 10  13 243  21 235  23 233 247
  9  11  10  12  54  55  39  51
 53 175  50  70  64 126 230 127
254  53  40  79  14   1   6   8
 33 231  64 254  51  40  22  46
223 254  48  40  16  72 254  54
 40  11   6   4 254  55  40   5
 46 227 254  39 192 123 134 245
229 197 254  63  56  30 254 148
 48  26 205 187  64 254   2  48
 19 245 205 141  66 241 254   0
 40  10 193 225 121 254   1  40
  5 241  24 218
16714        < 65   74 >
193 225 241  35  16 211 201 126
230 128  33 228  64  32   2  46
241  22   3 123 134 229 245 254
 63  56  32 254 148  48  28 205
187  64 254   0  40  28 254   1
 32  17 122 254   1  32  12 205
141  66 123 254  82  56  19 254
126  48  15 241 225  43  21  32
210 201 122 254   1 196 141  66
 24 241 241 225  95  24 197 229
197 213 229 197  85  33  64  64
205  36   7 205  10  67 120 132
 79 241 205  10
16814        < 65   174 >
 67 225 205  24  67  48   1 128
 79 225 209  94 114 229 213 205
 24  67  48   1 144 245 205 247
 66 205   1  66 193  48   2   4
  4 209 225 115 225 205 250  66
205  24  67  48   1   5 205 250
 66 205 247  65 120  33  60  64
119 235  33  65  64 190 216   1
  5   0  24  11  33  99  64  17
 70  64   1  28   0  56   1 235
237 176 201  58  55  67 198  48
 33  62  67  71 237 177  43  34
128  64   6  66
16914        < 66   18 >
 33  62  67  35 229 197  93 205
191  64 254   0  32  25 205 247
 66 107 205 247  64 205 247  66
205 130  66  40  10  42 128  64
189  32 245 193 225  55 201 193
225  16 216 167 201   6   5  62
  8  33 159  67  35 119  15 252
205 160  64 254   3  32 238  34
  7  64  93 205 247  64  33 161
 67 205 160  64 254   2 235  48
220 205 130  66  40 215 185  32
248 205 255  66 217 205   1  66
217  55   8 205
17014        < 66   118 >
235  66 205 150  66  24 194 112
121  18  24 249  33  70  64  53
126  60 200 133 111 126 201  33
 70  64  52 126 133 111 113 201
175  50  65  64   6  66  33  62
 67  35 229 197  93 205 191  64
254   3  32  41 107  34   7  64
205 247  64 205 130  66  40  29
 95  22  67 205 255  66 217 167
205 242  65 205   1  66 217 112
121  18  56   3 205 153  65  55
205 242  65  24 222 193 225  16
200  58  65  64
17114        < 66   218 >
254   0  40 254  33  69  64 126
 43  43  94  22  67  18  43 110
 98 203  69  54 128  40   2  54
  0 205 247  66 201  33  55  67
126 198 128 119 201  42   7  64
 26  79 126  54   0  18  71 201
230 127  33 242  64   6   5 190
200  35  16 251 120 201 125 217
 50 128  64 205  16  66 217 121
201 118   0   2   2   0 226 118
  0   3   4   0 249 213  61 118
  0   4 233   0 234  33  67  67
 17   0  72   1
17214        < 67   62 >
205   0 237 176 201 128   8 169
183 173 118  29   8  55  51  39
 48  54  39  51  55 118  30   8
 53  53  53  53 128  53  53  53
118  31   8   0 128   0 128  53
128   0 128 118  32   8 128   0
128   0 128   0 128   0 116  33
  8   0 128   0 128   0 128   0
128 118  34   8 128   0 128   0
128   0 128   0 118  35   8 181
181 181 181 181 181 181 181 118
 36   8 183 179 167 176 182 167
179 163 118   8
17314        < 67   162 >
  8  45  44  43  42  41  40  39
 38 118   8   8   8   8   8   1
  0   4 205 245   8  33   0  72
  6 110 197 229 126 215 225 193
 35  16 247  33 125  64  34  41
 64 195   7   3
```


Run the machine-code program in Rem 4 by typing

RAND USR 17207.

This copies Rem 4 above RAMtop and it is therefore protected when the next commands are typed in. Delete line 4, then type Clear.

This removes all the stored variable making available the maximum possible RAM space for our program. Now add the variable X by typing:

LET X = 16959

This sets up the variable X for the Basic program. Line 3 Rand UsrX actually calls the driver routine. Now type:

RAND USR 18542

At this stage you save the program on tape. The machine-code program loaded above RAMtop will execute. The first section creates a display file on the board and pieces, the second section loads into address 16425 — Sinclair variable Nxtlin, the address of the next program line to be executed — this is the actual start of Rem 1, that is, address 16509.

The program then jumps to the Save routine in ROM; this will Save the display just produced and then auto-run at line 1. The whole of the above most be done in fast mode, or else the Save routine will not be executed.

Now for a brief description of the function of each of the machine-code segments: **Kybd** is a routine which sets up machine control of the keyboard such that only the eight key codes from code 29 and the eight key codes from code 38 are acceptable entries. Any other key depression is ignored. The subroutine **TKP** just scans the keyboard waiting for an appropriate key to be depressed. The alphanumeric entry is then translated to a board address.

STR: this routine takes the board address and determines whether the contents are: different from the current mover-colour; empty; the board surround or the same colour as the current mover.

Piece: this sets up pointers to possible move tables and number of steps and directions. **Move** produces a list of all legal moves available to the piece under consideration.

Pawn produces a list of all possible legal moves including initial double moves. **Check** locates current mover's Kings and stores the position in the attack register. **Square Attack** determines whether the opposition can attack the square in the attack register.

Score provides a move score based on the following: first, the "To" position results in taking of a piece. Second, the "From" position is attacked. Third, the "To" position is attacked. Fourth, "To" enables the computer to obtain a check and finally the "From" position is defended.

The current move score is then compared with the previous best and if this is superior, the move is saved as the best so far.

Shift moves the current move list to a safe

(continued on next page)

(continued from previous page)
position whilst Check is being evaluated, and then recovers the move list on completion. It is also used to shift the best move so far up into the move list.

PSC gives a score to a chess piece Q(5), R(4), B(3), N(2), P(1).

MPScan scans the board for computer pieces and, using move and score, determines all legal moves and saves the best. **INC** determines whether a square is being attacked.

Driver Main control logic, uses all the other subroutines to provide program control.

TestList: tests to see if there are any moves in the move list. **AddList:** adds to the current legal move list another entry on the end.

The program is copyright. You can produce a copy of the program from the listings for your own use, but you should not copy the listings or parts thereof and offer for sale. ■

Figure 4. Code map continued from page 100.

```
TKP
16514 PUSH HL      229
(130) PUSH BC      197
( 64) CALL NN      205 187 2
      LD B H       68
      LD C L       77
      LD D L       85
      INC D        20
      JP Z DIS     40 247
      CALL NN      205 189 7
      LD A (HL)    126
      POP BC       193
      PUSH BC      197
      CP C         185
      JP Z DIS     40 6
      INC C        12
      DJNZ DIS     16 250
      POP BC       193
      JR DIS       24 231
      POP BC       193
      POP HL       225
      LD(HL) A     119
      RET          201
KYBD

16544 LD BC NN     1 29 8
(160) CALL NN      205 130 64
( 64) DEC HL       43
      LD C N       14 38
      CALL NN      205 130 64
      INC HL       35
16557 LD A (HL)    126
      SUB N        214 28
      LD B A       71
      LD C N       14 11
      XOR A        175
      ADD C        129
      DJNZ DIS     16 253
      ADD N        198 97
      DEC HL       43
      SUB (HL)     150
MOVE
      LD A E       123
      ADD A (HL)   134
      PUSH AF      245
      PUSH HL      229
      PUSH BC      197
      CP N         254 63
      JP C DIS     56 30

      CP N         254 148
      JP NC DIS    48 26
      CALL STR     205 187 64
      CP N         254 2
      JP NC DIS    48 19
      PUSH AF      245
      CALL ALIST   205 141 66
      POP AF       241
      CP N         254 0
      JP Z DIS     40 10
      POP BC       193
      POP HL       225
      LD A C       121
      CP N         254 1
      JP Z DIS     40 5
      POP AF       241
      JR DIS       24 218
      POP BC       193
      POP HL       225
      POP AF       241
      INC HL       35
      DJNZ DIS     16 211
      RET          201
```

```
STR
16571 LD C A       79
(187) LD L A       105
( 64) LD H N       38 67
16575 LD A (HL)    126
(191) LD B N       6 1
( 64) AND N        230 127
      CP N         254 0
      JP Z DIS     40 20
      INC B        4
      CP N         254 118
      JP DIS       40 15
      CP N         254 39
      JP C DIS     56 11
      LD A (HL)    126        '0' DIFF
      INC B        4
      LD L N       46 55      '1' EMPTY
      ADD (HL)     134
      BIT 7,A      203 127    '2' WALL
      JP Z DIS     40 2
      LD B N       6 0        '3' SAME
      LD A B       120
      LD L C       105
      RET          201
TABLES
16607 1 11 -1 -11 -10 -12 12 10
16615 13 -13 21 -21 23 -23 -9 9
16623 11 10 12
16626 54 55 39 51 53
PIECE
16631 XOR A        175
(247) LD(NN) A     50 70 64
( 64) LD A (HL)    126
      AND N        230 127
      CP P         254 53
      JP Z DIS     40 79
      LD C N       14 1
      LD B N       6 0
      LD HL NN     33 231 64
      CP N         254 51
      JP Z DIS     40 22
      LD L N       46 223
      CP K         254 48
      JP Z DIS     40 16
      LD C B       72
      CP Q         254 54
      JP Z DIS     40 11
      LD B N       6 4
      CP R         254 55
      JP Z DIS     40 5
      LD L N       46 227
      CP B         254 39
      RET NZ       192

SHIFT
16802 LD HL NN     33 99 64
(242) LD DE NN     17 70 64
( 65) LD BC NN     1 28 0
      JP C DIS     56 1
      EX DE HL     235
      LDIR         237 176
      RET          201
PSC
17162 AND N        230 127
(10)  LD HL NN     33 242 64
(67)  LD B N       6 5
      CP (HL)      190
      RET Z        200
      INC HL       35
      DJNZ DIS     16 251
      LD A B       120
      RET          201
MPSCAN
17046 XOR A        175
(150) LD (NN) A    50 65 64
( 66) LD B N       6 86
      LD HL NN     33 62 67
      INC HL       35
      PUSH HL      229
      PUSH BC      197
      LD E L       93
      CALL STR2    205 191 64
      CP N         254 3
      JP NZ DIS    32 41
      LD L E       107
      LD (NN) HL   34 7 64
      CALL MOVE    205 247 64
      CALL TL      205 130 66
      JP Z DIS     40 29
      LD E A       95
      LD D N       22 67
      CALL PMOVE   205 255 66
      EXX          217
      AND A        167

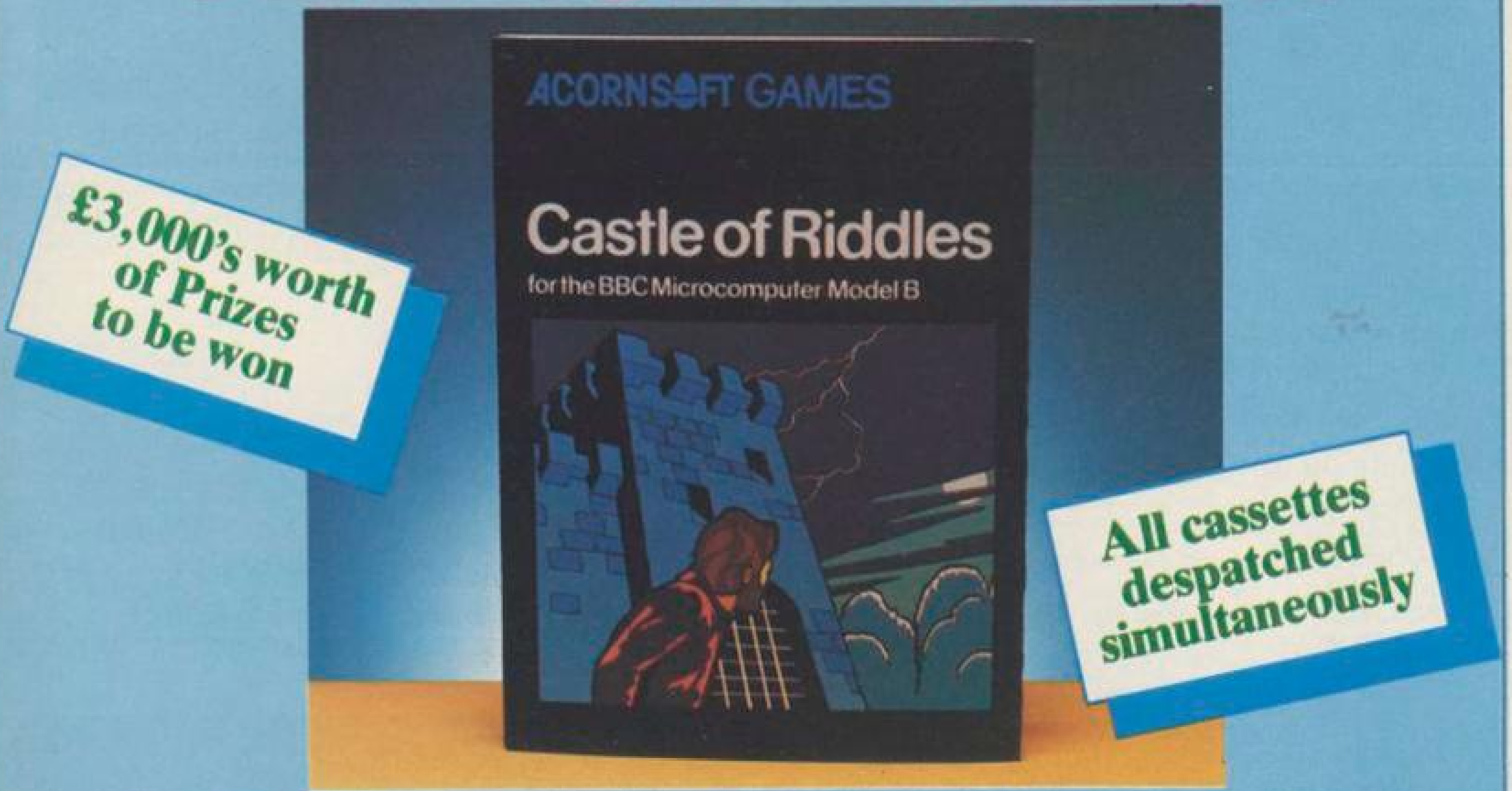
      CALL SHIFT   205 242 65
      CALL CHK     205 1 66
      EXX          217
      LD(HL) B'    112
      LD A C       121
      LD(DE) A     18
      JP C DIS     56 3
      CALL SCORE   205 153 65
      SCF          55
      CALL SHIFT   205 242 65
      JP DIS       24 222
      POP BC       193
      POP HL       225
      DJNZ DIS     16 200
      LD A (NN)    58 65 64
      CP N         254 0
      JP Z DIS     40 254
      LD HL NN     33 69 64
      LD A (HL)    126
      DEC HL       43
      DEC HL       43
      LD E (HL)    94
      LD D N       22 67
      LD (DE) A    18
      DEC HL       43
      LD L (HL)    110
      LD H D       98
17131 BIT 0.L      203 69
(235) LD(HL) N     54 0
( 66) JP Z DIS     40 2
      LD(HL) N     54 128
      CALL CHGMV   205 247 66
      RET          201
INC
17176 LD A L       125
(24)  EXX          217
(67)  LD(NN) A     50 128 64
      CALL SQ.AT   205 16 66
      EXX          217
      LD A C       121
      RET          201
DRIVER
16959 LD B N       6 5
(63)  LD A N       62 8
(66)  LD HL NN     33 159 67
      INC HL       35
      LD(HL) A     119
      DJNZ DIS     16 252
      CALL KT      205 160 64
      CP N         254 3
      JP NZ DIS    32 238
      LD (NN) HL   34 7 64
      LD E L       93
      CALL MOVE    205 247 64
      LD HL NN     33 161 67
      CALL KT      205 160 64
      CP N         245 2
      EX DE HL     235
      JP NC DIS    48 220
      CALL TL      205 130 66
      JP Z DIS     40 215
      CP C         185
      JP NZ DIS    32 240
      CALL PMOVE   205 255 66
      EXX          217
      CALL CHK     205 1 66
      EXX          217
      JP C DIS     56 8
      CALL CHGSQ   205 235 66
      CALL MPSCAN  205 150 66
      JP DIS       24 194
      LD (HL) B    112
      LD A C       121
      LD (DE) A    18
      JP DIS       24 249
TEST LIST
17026 LD HL NN     33 70 64
(130) DEC (HL)     53
( 66) LD A (HL)    126
      INC A        60
      RET Z        200
      ADD L        133
      LD L A       111
      LD A (HL)    126
      RET          201
```

```
PAWN
16721 LD A (HL)    126
(81)  AND N        230 128
(65)  LD HL NN     33 228 64
      JP NZ DIS    32 2
      LD L N       46 241
      LD D N       22 3
      LD A E       123
      ADD (HL)     134
      PUSH HL      229
      PUSH AF      245
      CP N         254 63
      JP C DIS     56 32
      CP N         254 148
      JP NC DIS    48 28
      CALL STR     205 187 64
      CP N         254 0
      JP Z DIS     40 28
      CP N         254 1
      JP NZ DIS    32 17
      LD A D       122
      CP N         254 1
      JP NZ DIS    32 12
      CALL ALIST   205 141 66
      LD A E       123
      CP N         254 82
      JP C DIS     56 19
      CP N         254 126
      JP NC DIS    48 15
      POP AF       241
      POP HL       225
      INC HL       43
      DEC D        21
      JP NZ DIS    32 210
      RET          201
      LD A D       122
      CP N         254 1
      CALL NZ ALIST 196 141 66
      JP DIS       24 241
      POP AF       241
      POP HL       225
      LD E A       95
      JP DIS       24 197
CHK
16897 LD A (NN)    58 55 67
( 1)  ADD N        198 48
(66)  LD HL NN     33 62 67
      LD B A       71
      CPIR         237 177
      DEC HL       43
      LD (NN) HL   34 128 64
SQ.AT
16912 LD B N       6 86
(16)  LD HL NN     33 62 67
(66)  INC HL       35
      PUSH HL      229
      PUSH BC      197
      LD E L       93
      CALL STR2    205 191 64
      CP 0         254 0
      JP NZ DIS    32 25
      CALL CHEMV   205 247 66
      LD L E       107
      CALL MOVE    205 247 64
      CALL CHEMV   205 247 66
      CALL TL      205 130 66
      JP Z DIS     40 10
      LD HL(NN)    42 128 64

      CP L         189
      JP NZ DIS    32 245
      POP BC       193
      POP HL       225
      SCF          55
      RET          201
      POP BC       193
      POP HL       225
      DJNZ DIS     16 216
      AND A        167
      RET          201
SCORE
16793 PUSH HL      229
(153) PUSH BC      197
( 65) PUSH DE      213
      PUSH HL      229
      PUSH BC      197
      LD D L       85
      LD HL NN     33 64 64
      CALL NN      205 36 7
      CALL PSC     205 10 67
      LD A B       120
      ADD A N      132
      LD C A       79
      POP AF       241
      CALL PSC     205 10 67
      POP HL       225
      CALL INC     205 24 67
      JP NC DIS    48 1
      ADD A B      128
      LD C A       79
      POP HL       225
      POP DE       209
      LD E (HL)    94
      LD (HL) D    114
      PUSH HL      229
      PUSH DE      213
      CALL INC     205 24 67
      JP NC DIS    48 1
      SUB B        144
      PUSH AF      245
      CALL CHEMV   205 247 66
      CALL CHK     205 1 66
      POP BC       193
      JP NC DIS    48 2
      INC B        4
      INC B        4
      POP DE       209
      POP HL       225
      LD (HL) E    115
      POP HL       225
      CALL CHG     205 250 66
      CALL INC     205 24 67
      JP NC DIS    48 1
      DEC B        5
      CALL CHG     205 250 66
      CALL CHEMV   205 247 66
      LD A B       120
      LD HL NN     33 60 64
      LD (HL) A    119
      EX DE HL     235
      LD HL NN     33 65 64
      CP (HL)      190
      RET C        216
      LD BC NN     1 5 0
      JP DIS       24 11
```

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BASIC DICTIONARY

This dictionary, compiled by Tony Edwards, will explain the function of common Basic words as used in popular machines, enabling you to work out your own machine's equivalent. A useful complement to our recent series on Basic dialect translation.

MOD A little-used function which returns the remainder when its two arguments — one in front and one behind — are divided.

MODE A statement used to select from the available screen formats available on some computers.

MOVE A statement which is used on the BBC Micro which moves the graphics pointer to the position specified by the argument. The same as Plot 4, argument, argument.

N

N. Used in TRS-80 level 1 and Palo Alto Tiny Basic as an abbreviation for NEW.

NE An alternative operator equivalent to <> not equal to. However it also stands as an abbreviation for NEW. The difference can be judged by the context of the line using it.

NEW A command or statement which effectively destroys any resident Basic program and returns to the command mode. It often also clears the screen.

NEX An abbreviation for the NEXT statement.

NEXT the statement used to return program execution to the preceding FOR statement and increment the counter. If the counter is out of the preset limit the execution continues with the line after the NEXT statement. An ANSI standard word. Some compilers allow an implied NEXT.

NORMAL The statement used on the Apple II to cancel the flashing and inverse video displays.

NOT A logical operator used as a negation in an IF statement. For example:

```
IF X = 0 AND Y NOT 0 THEN END
```

which terminates the program when X = 0 if Y is not also 0. Different computers handle the comparison of the arguments in different ways. See *Your Computer* August 1982, page 58 for an explanation of logical processes.

NOTRACE A command or statement which switches off the TRACE mode. Usually used within a program only during development.

NULL A statement which controls the number of null characters placed at the end of a line.

O

OLD A command which undoes the effect of a previous NEW statement or command.

ON ERROR GO TO A statement which allows a program to escape from a fatal error by ignoring the error and branching to the specified line number. The BBC Microcomputer equivalent is ON ERROR statement which allows statements other than the unconditional GOTO branch to be executed.

ON . . . G. The Microsoft Level 1 and Palo Alto Tiny Basic abbreviation for ON . . .GOTO.

ON . . . GOSUB A multiple branching statement of the form:

```
ON X GOSUB A, B, C . . . .
```

When encountered control is transferred to the Xth subroutine after GOSUB.

ON . . . GOT The PDP-8E abbreviation for ON . . . GOTO.

ON . . . GOTO A multiple-branching statement of the form:

```
ON X GOTO A, B, C . . . .
```

When encountered, control is transferred to the Xth line number after GOTO. An ANSI standard statement.

OPEN IN A function which returns the channel number of the file named, and opens it for input or updating.

OPEN OUT A function which returns the channel number of the file named and opens it — or creates it — for output or updating.

OPTION A standard ANSI word, but a little-used statement which assigns a value, usually 0 to 10 which becomes the number of the lowest array element. It is often followed by the word BASE.

OR A logical operator used in an IF statement.

```
IF X = 0 OR Y = 0 THEN END
```

terminates the run if either X or Y are 0. See *Your Computer* August, 1982, page 58, for an explanation of logical processes.

OUT The statement used to send a byte to a specified output port. Both byte value and port number should be integers between 0 and 256 — decimal.

P

P. A common abbreviation for PRINT used in TRS-80 level, Palo Alto Tiny Basic, Atom and BBC Microcomputer Basic. It is equivalent to "?".

P.A. The TRS-80 — level 1 — abbreviation for PRINT AT.

PAGE A pseudo-variable which controls the starting address of the current text area on the BBC Microcomputer. It is used to enable multiple programs to be stored simultaneously in RAM. It must always be equated to an integer multiple of 256.

PAUSE A statement used on ZX machines to halt processing for a specific period before continuing. It is the equivalent of the more common WAIT, and can be simulated with a dummy FOR-NEXT loop.

PDL A special function used in Apple II Basic to return the settings of paddles used as games controllers.

PEEK A statement which is used on many machines to return the value stored in a specified memory address from Basic.

PI A function which when called returns the decimal value of pi. It is usually set to return 3.14159265.

PIN A function which reads the decimal value of a byte of information available at a specified part. *See INP.*

PLOT A statement used in Apple II Basic to control the colour graphics block in a specified screen position. The same word is used on other machines for example, the BBC Microcomputer, to provide more extensive control over graphics features.

POINT A statement used on the TRS-80 to test a specified graphics block to see if it is switched on.

POKE The statement used on many machines to place some desired decimal value into a specified memory address. It cannot be used to load ROM area addresses but can alter memory contents in reserved RAM areas.

POS A function which returns the current horizontal position of the cursor on the screen. The left-hand position is usually numbered 0, not 1.

PR # An Apple II command which diverts output to the peripheral device indicated by the value of the argument.

PRI The PDP-8E abbreviation for PRINT.

PRINT A standard ANSI word. It is usable both as a command or a statement and causes output to be printed on to the screen.

PRINT # A statement or command which writes the output on to a peripheral device — often a cassette recorder — indicated by the argument.

PRINT AT A statement or command which causes output to appear at a specific location on the screen as indicated by the argument.

PRINT @ same as PRINT AT.

PRINT USING A statement which allows output to appear in a specific format. Different machines have different available formats. ■

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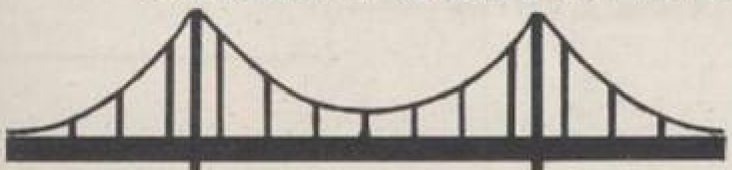
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CONTROL

PRINTING W

THE SINGLE-LINE display on the Microprofessor can make it difficult to keep track of programs more than a couple of dozen bytes long. The simple remedy is to work through the program writing down the machine code by hand for later checking and correction. This process has its drawbacks — inaccuracy and the amount of time involved, for example — but it works. My previous article concerned serial and parallel ports for the transfer of data between the Central Processor Unit — CPU — and peripheral devices. This article concentrates on the Z-80 PI/O — Parallel Input/Output chip — and the connections and software that will allow it to control a printer using a Centronics interface. Although the program is written for the Microprofessor, it can be transported immediately to any other Z-80 based machine. The only change is to modify the addresses of the PI/O registers.

The Z-80 PI/O has four registers controlled by the Port B/A Select — pin 6 — and Control/Data Select — pin 5 — lines. On the Microprofessor these lines are decoded as follows:

Port number	Function
80 hex	Data A
81	Data B
82	Control A
83	Control B

Your computer may not decode these lines sequentially but you should be able to find out which port number corresponds to which function.

The pin connections for the Z-80 PI/O are set out in figure 1. On the Microprofessor computer the PIO data buses and control lines are brought out to a standard 40-way connector on the top left-hand side of the printed-circuit board — PCB. The PCB is numbered on the top side so that you can see easily which pin connects to which line. The lines brought out to the connector are set out in figure 2. Note that in addition to the PIO lines the Counter Timer Circuit — CTC connections are also shown.

I made up a lead to fit the Microprofessor PI/O connector by clamping a socket on to a piece of 40-way ribbon cable about 8in. long. Unfortunately I could buy only a 50-way socket and after fastening the two halves together I cut the socket with a hacksaw to remove the last 10 connectors. The SGS socket held together without the locking clamps at one end and has worked satisfactorily. I left some cable free on one side of the socket and trimmed the excess to about 3 or 4mm. with a pair of scissors. At the other end I split the cable into its individual wires with the scissors so that each wire was about 4in. long. Next I settled down to make the appropriate connections between the Microprocessor PI/O connector and a plug that would fit my Centronics lead.

Making the correct links was hard work. A short Basic program on another machine to work through the connections telling me which pin had to be soldered to which wire would have been a good idea, but in the end I used an ordinary ohmmeter or continuity checker and a list of what had to be done.

After resoldering all the connections four times and using an oscilloscope to check that the strobe signal was actually present, it worked. The list of connections you will need is set out in figure 3. If you are working with a machine other than the Microprofessor take the connections directly from the PI/O column to the Centronics column.

Note that these connections are a minimum Centronics interface and do not take account of other signals from the printer such as the Slct or PE lines. More important, the Acknlg line is not used to acknowledge receipt of each byte of data as the Busy signal becomes high during data entry and printing. The Busy signal is a composite of four conditions in which the printer is unable to receive more data. It works satisfactorily with an Epson MX-80F/T printer.

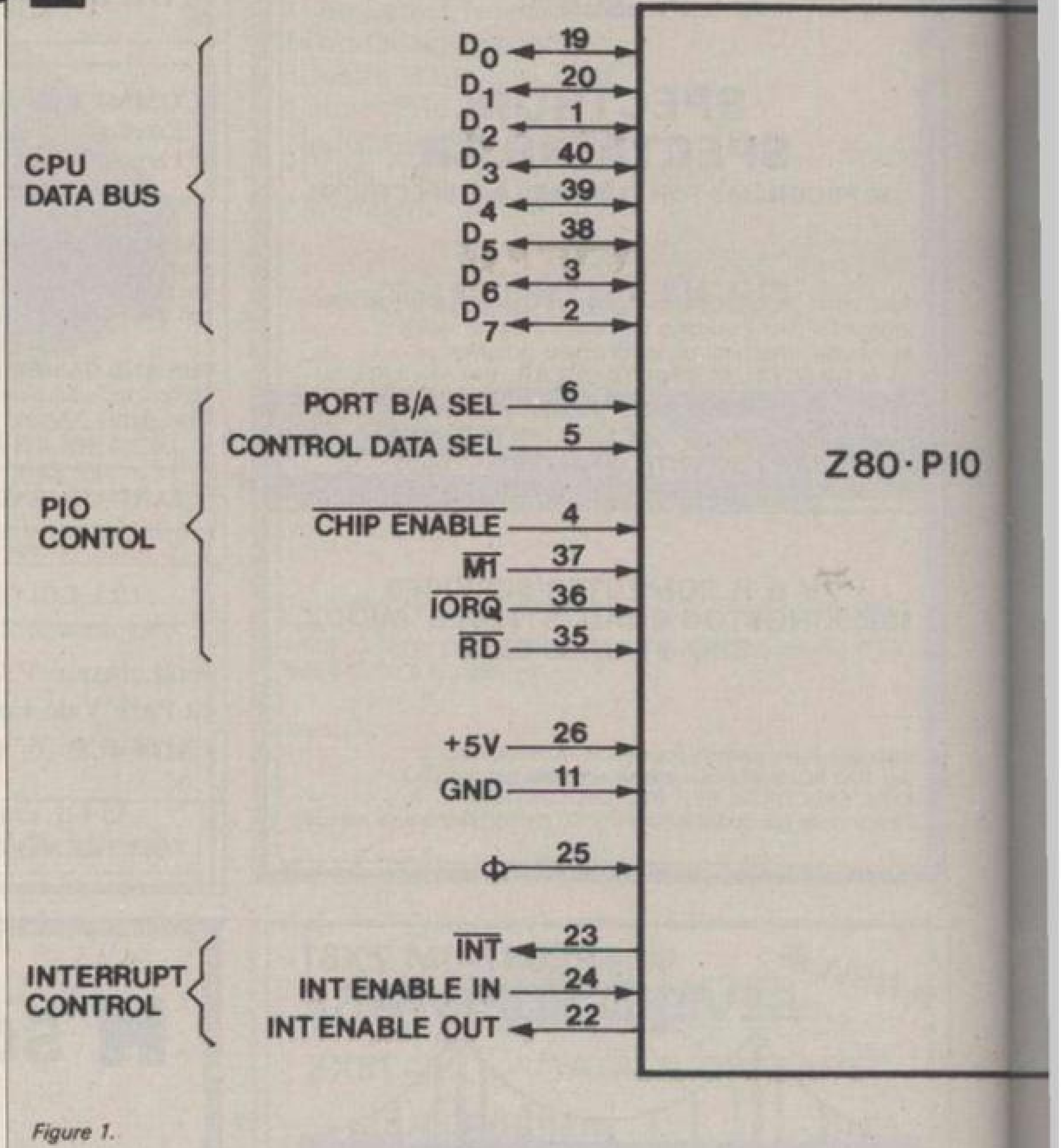
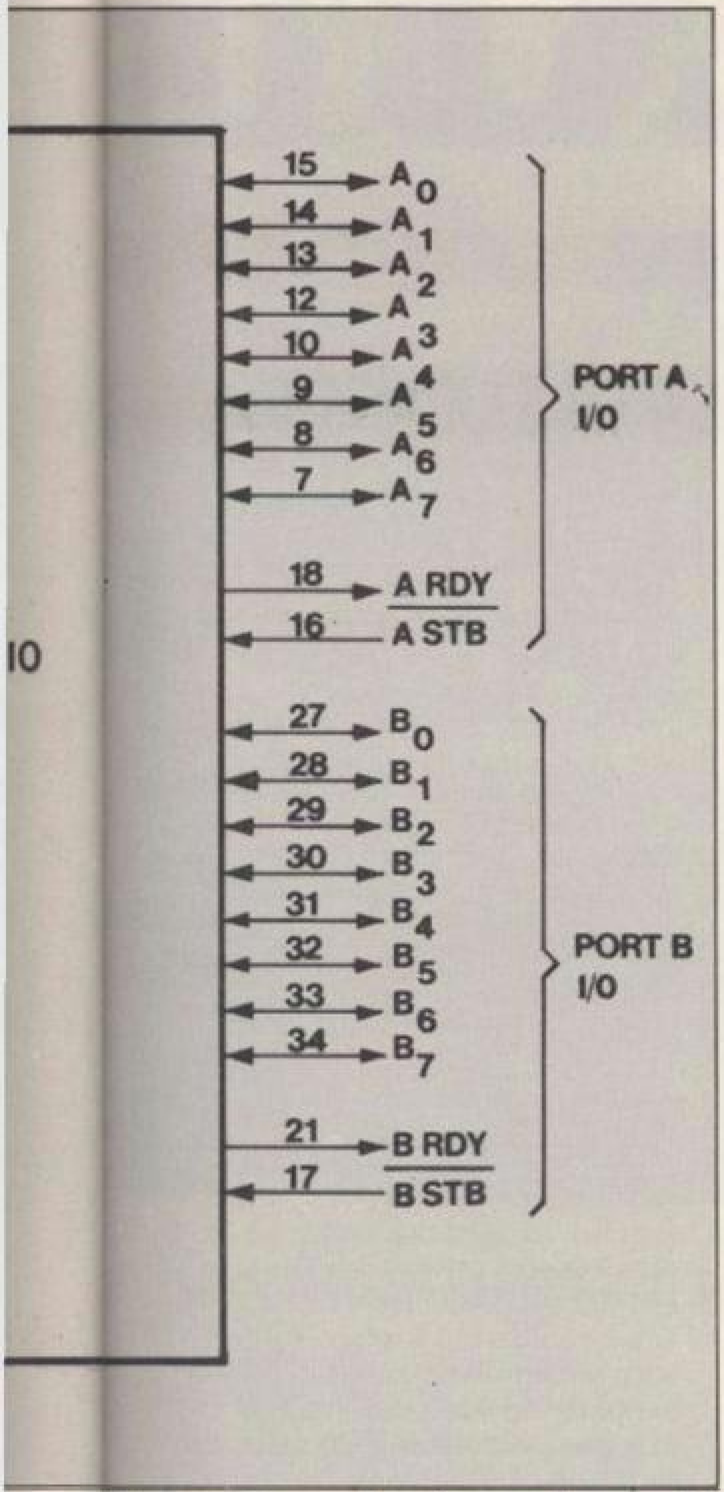


Figure 1.

Figure 4 is a printout obtained from the Microprofessor using the Centronics interface. There are three subroutines — SR — in the program, each of which may be used by other programs. The SR starting at 1800 sets up the PI/O to output a character to the printer. It is time-consuming to set the control registers for each byte, but any printer is so slow by comparison with the computer that the additional time is negligible.

Subroutine functions

After saving register A, the accumulator, by Pushing it on the stack, the SR sets port A of the PI/O to Output mode and then sets port B to Input mode. The SR then reads an input from port B and loops until bit 7 of port B is zero — that is, it loops until the Busy signal from the printer is low or inactive. When the printer is ready to receive data the SR recovers the contents of the accumulator from the stack



On his odyssey through the control potential of Z-80 based micros, John Dawson reaches the parallel input/output chip — and shows you how to use it to drive a printer.

PI/O pin	Microprofessor pin	code	Function	Centronics pin
18	16	A RDY	STROBE	1
15	15	PAO	DATA 1	2
14	14	PA1	DATA 2	3
13	13	PA2	DATA 3	4
12	12	PA3	DATA 4	5
10	10	PA4	DATA 5	6
9	9	PA5	DATA 6	7
8	8	PA6	DATA 7	8
7	7	PA7	DATA 8	9
11	11	GROUND	0 Volts	16
34	28	PB7	BUSY	11

Figure 3.

```
1800  F5 3E 0F D3 82 3E 4F D3 83 DB 81 17 38 FB F1 D3
1810  80 C9 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1820  F5 1F 1F 1F 1F CD 30 18 F1 CD 30 18 C9 00 00 00
1830  E6 0F C6 30 FE 3A 38 02 C6 07 CD 00 18 C9 00 00
1840  3E 0D CD 00 18 3E 0A CD 00 18 16 00 06 10 7C CD
1850  20 18 7D CD 20 18 3E 20 CD 00 18 CD 00 18 7E CD
1860  20 18 3E 20 CD 00 18 23 10 F4 1D 20 D3 3E 0D CD
1870  00 18 76 FF 00 FF 60 77 08 77 00 FF 00 FF 21 FF

0000  06 00 10 FE 3E 90 D3 03 3E C0 D3 02 31 AF 1F 3A
0010  E5 1F FE A5 C4 C1 03 21 00 10 CD F6 05 28 02 26
0020  18 22 DC 1F 26 00 18 0A E3 2B E3 22 E8 1F 18 0E
0030  18 34 22 D2 1F 18 1D 71 E5 2A EE 1F E3 C9 32 E7
0040  1F 2A E0 1F 3A E2 1F 77 3E 80 D3 02 3A E7 1F 2A
0050  E8 1F 00 C9 21 9F 1F 22 D0 1F AF 32 E6 1F DD 21
0060  9F 07 C3 D0 00 FF 32 E7 1F 3E 90 D3 03 3E C0 D3
0070  02 3A E7 1F 22 E8 1F E1 22 DE 1F 22 DC 1F 2A E8
0080  1F ED 73 D0 1F 31 D0 1F FD E5 DD E5 D9 E5 D5 C5
0090  D9 08 F5 08 E5 D5 C5 F5 ED 57 32 D3 1F 3E 00 E2
00A0  A4 00 3E 01 32 D2 1F 31 AF 1F 2A D0 1F DD 21 B5
00B0  07 2B CD F6 05 20 19 2B CD F6 05 20 13 DD 21 AF
00C0  07 00 00 11 62 E0 19 38 07 DD 21 B6 1F 37 18 04
00D0  AF 32 E4 1F 3A E2 1F 2A E0 1F 77 DC 0B 04 31 AF
00E0  1F CD FE 05 CD CB 06 18 F5 FE 10 38 24 21 E6 1F
00F0  CB C6 D6 10 FE 08 21 37 07 DA B0 03 DD 21 B6 1F
```

Figure 4.

VITH THE Z-80 PI/O

and sends it to the printer by outputting the data to port A. The SR then returns to the calling program.

The second SR starts at 1820 and, with the SR at 1830, splits a byte of data into two hexadecimal digits and prints the resulting values. The top four bits of the byte are rotated to the lower half and printed by the SR at 1830 after being converted to an ASCII number. The lower four bits are then processed in the same way.

The final program starting at 1840 will print a section of memory in the format shown in figure 4. The program starts by printing a carriage return character — 0D hex — and then a line-feed character — 0A hex — to position the print head correctly. If your printer automatically prints a line feed after each carriage return you may wish to replace the instructions — 3E 0A CD 00 1B — with no operation — NOP instructions — 00 hex.

The start address is passed to the program in register pair HL and the number of lines to be printed in register E. On the Microprofessor you can set these registers directly before executing the program at 1840. On other machines you may jump to the program with the correct values set in HL and E and may also change the Halt instruction — 76 — at the end of the program to C9 — return from subroutine.

Length of line

The length of the line to be printed is set by loading register B with 10 hex at address 184B and 184C. If your printer cannot print lines 54 characters long, it is best to alter 184C to a suitable value.

Changing the location of the programs is easy; simply a matter of altering the addresses to which the absolute Call — CD — instructions refer. ■

Figure 2. P2 PIN FUNCTION

PIN NO	SIGNAL	PIN NO	SIGNAL
1	NC	21	PB0
2	NC	22	PB1
3	NC	23	PB2
4	NC	24	PB3
5	NC	25	PB4
6	NC	26	PB5
7	PA7	27	PB6
8	PA6	28	PB7
9	PA5	29	NC
10	PA4	30	GND
11	GND	31	CK/TR0
12	PA3	32	CK/TR1
13	PA2	33	CK/TR2
14	PA1	34	CK/TR3
15	PA0	35	ZC/TO0
16	ASTB	36	ZC/TO1
17	BSTB	37	ZC/TO2
18	ARDY	38	PIO IEO
19	BRDY	39	CTC IEI
20	NC	40	NC

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RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

INTELLIVISION

■ Our family has an Intellivision TV game. The makers of the game, Mattel, are bringing out a keyboard which — when plugged into the game — converts it into a microcomputer. Do you think it is worth buying this keyboard?

P Monks, Gravesend, Kent.

THE KEYBOARD unit has only been introduced in test markets in America, for around $700, and the indications are that it will not be released in the States. This being so, it is unlikely to come out in this country, but the company may well have other plans. Whenever you think about upgrading a TV game into a computer, you have to ask what sort of computer you will end up with. The chances are that you will get a fairly slow, limited computer, locked to the technology of the time when the computer game itself was built. Although I would not say "No, it is not worth it" you need to ask three things: how much is the extra unit? Can I buy a complete computer which is as good, or better, for the price of the keyboard unit? Even if the keyboard is cheaper than buying a computer, how good a computer will I end up with?

POKE SURPRISE

■ While experimenting with Poking on my ZX-81 I came across a real surprise. In response to random Poke, the computer came back with the report code 10. As the manual doesn't have this report code in it, could you tell me what it means?

Tim Steyning, Shoreham, Sussex.

YOU HAVE probably accidentally used the ZX-81's error-trapping facility — RST — which allows the computer to generate restart codes, and return to command mode.

MOUSE RULES

■ I wish to build a robot mouse to enter competitions where the mouse has to solve a maze. What are the rules of such competitions?

Martin Hamish, Glasgow.

THERE ARE a number of rules for the Euromouse Maze Contest, and these are subject to change, depending on the conditions set by the competition organisers. In general though, the rules include reference to the size of the maze — 16 by 16 squares, based on a 7in. matrix, the walls 6.5in. apart, 2in. high, painted white with red tops — and the target post — 1in. square, 8in. high. These measurements are allowed to be within five percent of the stated measurements. Each mouse is allowed a maximum of 15 minutes to perform, and if the mouse succeeds in finding its way from the start to the maze centre, the time is noted, so the handlers can — if they so wish — set the mouse to make a second, and subsequent run. The shortest time is counted as the mouse's time. The mouse itself may be no larger than 25cm. square. The mouse is allowed to bulge above the top of the maze. The Micromouse Maze contest was first held in the US by IEEE Spectrum.

CRASH PROBLEM

■ Using a 64K RAMpack connected to my ZX-81, I am surprised that the system crashes as soon as Vars becomes greater than 32768. There is no problem in storing variables above this point, but it seems that the system is not able to hold program lines on the screen above 32K. Is it a bug in the system, or is there a trick to circumvent it?

E Neve, Brussels, Belgium.

I AM INFORMED that the computer will work perfectly so long as the display file does not over-run 32768. One way of making sure this does not happen, is to declare a giant array, such as DIM A$(16000), then delete it once the program length is greater than 16K.

AT RANDOM

■ Spurred on by Kathleen Peel's superb introduction to machine code for the ZX-81, I am attempting to learn how to use machine language. I am trying to write a game, but am having difficulties as I cannot find out how to select a random number in machine code. Could you help?

N Luff, Cove, Farnborough.

ONE WAY of doing this is to initialise a pointer to zero early on in your program, and then, while waiting for a key press or similar event, increment the pointer as you go through a waiting loop. You must ensure that if the pointer reaches 8192 — the extent of the ZX-81 ROM — it is reset to zero. Then, every time you need a random number, simply fetch the location in ROM pointed to, then increment the pointer again. Two books which may help you in your study of ZX-81 machine code are *Machine Language Made Simple* from Melbourne House, and *Mastering Machine Code on your ZX-81* from Interface.

PRIVACY

■ I am a member of my school computer club, and we have a Vic-20 computer. I have a few games and serious programs on my tapes. I was wondering if you could tell me how to add a security code into my tapes so that only I can run the program, as some of the programs are quite private.

J A Isles, Preston, Lancs.

THE SIMPLEST WAY to do this is to select an address in RAM which is not being used, then embed in your program the line USR (X), where X is the selected address. Before you run the program, you must Poke — in the direct mode — the address with 96. If you do not do this, the program will crash dramatically. In effect, you will have a program which no-one else can run.

SCROLL DOWN

■ Do you know of a routine which will scroll the ZX Spectrum screen display downwards? Also, do you know of a routine which will define whether or not a character position is occupied by a character?

Martin Banks, Bolton, Lancashire.

SCROLLING DOWNWARDS can be achieved by this routine. Enter anything you like for a $ — in line 20 — to see it in action:

```
5 REM Downward scroll
10 DIM a$ (704.)
20 INPUT a$
30 PRINT AT 0,0;a$
40 LET a$ = "" + a$(TO 672)
50 GO TO 30
```

The Screen$ routine does not pick up on user-defined characters. I suggest you use Attr instead, making sure that the character you wish to check on has been printed with local, rather than universal, Ink colour.

VERIFICATION

■ Does the BBC Micro support a Verify command or equivalent? Is it necessary? Can programs be made self-starting when loaded from tape such that all variables are also loaded? The Chain command clears only the dynamic variables but leaves the static variables — @% through to Z% — unchanged. Why?

S Hartley, Wakefield, West Yorkshire.

THE BBC MICRO does not have a Verify command which allows you to compare a program on tape with that which is in the computer. However, there are two ways you can check a program. One is by using *Cat which will indicate a tape error. The other way is to Save a program, New the computer, then load it. If it does not load, an Old will restore the original program to try it again. There is no simple way to make a program self-starting with variables intact. The variables @% through to Z% are stored in a separate area of memory — &400 to &460 — which is never cleared by the computer. Different operating systems load this area of memory with different values when the computer is turned on. If the computer is not switched off between programs, you can use this area to access variables from one program when using a subsequent program.

THE CHOICE

■ I have decided on buying a home micro. I have studied various kinds and narrowed the choice down to the Commodore 64 or BBC Model B. Can you help?

Nadim Ahmed, Walthamstow, London.

BOTH MACHINES have their strong points. While the BBC gives a higher graphics resolution there are not as many colours and no sprite facility; BBC Basic is undoubtedly the more powerful version but is harder to master. Only 8K RAM is available on the BBC in high-res mode as opposed to 24K on the 64. It could also be said that the promised introduction of Simons Basic on the Commodore machine may put it very slightly ahead of the BBC, but obviously, the additional cost must be considered. This list could well be extended but the question is really a matter of horses for courses.

WAIT FOR IT

■ Please could you tell me if the forthcoming Microdrive for the Spectrum will be able to operate on the ZX-81? If not, could you suggest some means of adapting it or interfacing it with my computer?

G Rathbone, Lincoln.

ALTHOUGH THE Microdrive is not designed to work on any computer other than the Spectrum, it is most probable that within weeks of the Microdrive's release, adaptors will be on sale to run Microdrives from a variety of computers, including the ZX-81. Just keep watching the *Your Computer* advertisements. ■

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

WE HAVE in recent issues looked at some interesting programs which make successive approximations of an irrational number, such as π, as the ratio of two rationals. The most efficient program that I have received so far can generate the approximation 355/133 for π in just two seconds — as opposed to the original eleven minutes! *Your Computer* is now going to offer a year's subscription to the author of the most accurate and efficient program for generating e — the base of natural logarithms.

D T Whiteside has sent a most interesting program which also deals with a π approximation. He quite rightly points out that with a programmable calculator we can deal exactly with irrational numbers such as certain square roots and constants. The motivation for this comes from a theorem first proved fully by the 18th century French mathematician Lagrange. This says that all positive rational numbers have square roots which can be expressed in terms of unit continued — fractions with a finite set of denominations,

$$q_i ; i = 1, 2 \ldots n$$

which repeat. The full interest in this result may be seen if I define a unit—continued fraction as

$$q_0 + \cfrac{1}{q_1 + \cfrac{1}{q_2 + \cfrac{1}{q_3 + \cfrac{1}{q_4}}}}$$

and so on.

Or, for short, any square root of a rational number may be written in the form: $\sqrt{\frac{a}{b}} = q_0 ; q_1, q_2, q_3 \ldots q_n, q_1, q_2 \ldots$

As you can see we can now determine any surd $\sqrt{\frac{a}{b}}$ by a defined mathematical series — something which the pocket calculator can calculate early. But, as Mr Whiteside also points out, these unit continued-fractions are only one of a general class of such fractions —

$$a_0 = \cfrac{a_1}{b_1 + \cfrac{a_2}{b_2 + \cfrac{a_3}{b_3 + \ldots}}}$$

It is with these generalised continued fractions that we can express constants such as π and e. For each constant there are an infinite number of different ways (of course) of expressing as a continued fraction.

It is the recursive ones which have interested mathematicians for

(continued on next page)

Program 3. Mr Jagota's FX-602p program.

```
PROGRAM                                                          STEP
  P0   Mac 1001 Min10 GSB P6                                     007
  P1   AC Min00 22 MinF AC 2 Min11 AC MR06 x≥F GOTO0 GOTO2       013
       LBL0 "Ar 06" Pause "BUST" Pause GOTO 5                    026
       LBL2 21 MinF AC MR06 x≥F GOTO1 GOTO3                      035
       LBL1 "PONTOON" Pause AC 3 Min 11                          049
       LBL3 GSB P5 M+08 "Ar06" "My turn Ar08" Pause AC Mr06      070
            MinF AC MR08 x=F GOTO6 GOTO5                         076
       LBL4 22 MinF AC MR08 x≥F GOTO6 GOTO5                      085
       LBL5 "I win" Pause GOTO7                                  095
       LBL6 "You Win" Pause AC MR05xMR11=M+10                    112
       LBL7 Mr10 x=0 GSB P8 AC MR10-50=x≥0 GOTO8 GSB P8          125
       LBL8 1 EXP4=MinF                                          131
       LBL9 AC MR10 x≥F GSB P9 GSB P6                            137
  P5   AC RAN#x10 + 1.5 = INT                                    011
 *P6   AC Min 05                                                 002
       LBL0 MR10-1="Total:#"HLT INT Min05 AC 50 MinF MR05        024
       x≥F GOTO1 GOTO0                                           027
       LBL1 AC MR10 MinF AC MR05 x≥F GOTO 0 GOTO 2               036
       LBL2 "Stake Ar05" Pause MR05 M-10 AC                      050
       LBL3 GSBP5 Min06"#:"HLT GSBP5 M+06";# "HLT GSBP5 M+06     068
       ";#:"HLT GSBP5 M+06 ";# "HLT GSBP5 M+06 ";#" Pause        081
       GSB P1                                                    090
  P7   "Play again?" Pause "Press P0" HLT GSB P7                 026
  P8   "You lost" Pause GSB P7                                   012
  P9   "You won" Pause GSB P7                                    011

       Total Steps Used : 301     Total Steps Left : 211
```

Memory	Contents
F	Variant
05	Your stake
06	Your total cards
08	Calculators card
10	Your total
11	Stake multiplier

Program	Function
P0	Game restart
P1	Stick

Program 1. Mr Whiteside's program for the TI-59

000	76	LBL	060	07	07
001	11	A	061	43	RCL
002	47	CMS	062	03	03
003	04	4	063	85	+
004	42	STD	064	43	RCL
005	01	01	065	04	04
006	01	1	066	65	×
007	42	STD	067	43	RCL
008	04	04	068	09	09
009	76	LBL	069	95	=
010	12	B	070	42	STD
011	01	1	071	08	08
012	44	SUM	072	43	RCL
013	00	00	073	07	07
014	43	RCL	074	42	STD
015	00	00	075	03	03
016	65	×	076	43	RCL
017	02	2	077	08	08
018	75	−	078	42	STD
019	01	1	079	04	04
020	95	=	080	43	RCL
021	42	STD	081	03	03
022	09	09	082	67	EQ
023	43	RCL	083	12	B
024	00	00	084	43	RCL
025	33	X²	085	04	04
026	42	STD	086	67	EQ
027	10	10	087	12	B
028	65	×	088	53	(
029	43	RCL	089	43	RCL
030	02	02	090	01	01
031	95	=	091	75	−
032	42	STD	092	01	1
033	05	05	093	54	)
034	43	RCL	094	55	÷
035	01	01	095	43	RCL
036	85	+	096	03	03
037	43	RCL	097	95	=
038	02	02	098	59	INT
039	65	×	099	42	STD
040	43	RCL	100	05	05
041	09	09	101	43	RCL
042	95	=	102	02	02
043	42	STD	103	55	÷
044	06	06	104	43	RCL
045	43	RCL	105	04	04
046	05	05	106	95	=
047	42	STD	107	59	INT
048	01	01	108	75	−
049	43	RCL	109	43	RCL
050	06	06	110	05	05
051	42	STD	111	95	=
052	02	02	112	22	INV
053	43	RCL	113	67	EQ
054	04	04	114	12	B
055	65	×	115	43	RCL
056	43	RCL	116	01	01
057	10	10	117	75	−
058	95	=	118	43	RCL
059	42	STD	119	03	03

(listing continued on next page)

(listing continued from previous page)

```
120   42 STD
121   01  01
122   65  ×
123   43  RCL
124   05  05
125   99 PRT
126   95  =
127   42 STD
128   03  03
129   43 RCL
130   02  02
131   75  -
132   43 RCL
133   04  04
134   42 STD
135   02  02
136   65  ×
137   43 RCL
138   05  05
139   95  =
140   42 STD
141   04  04
142   61 GTO
143   12  B
```

(continued from previous page)

centuries — the first noted recursive expression was produced in 1380!

$$\pi = 4(1 - 1/3 + 1/5 \ldots \mp \frac{1}{2n-1} \pm f_{2n})$$

where

$$f_n = \tfrac{1}{2} \times \cfrac{1}{n + \cfrac{1^2}{n + \cfrac{2^2}{n + \cfrac{3^2}{n + \cdots}}}}$$

A less unwieldy version from 1654 goes:

$$\pi = \cfrac{4}{1 + \cfrac{1^2}{2 + \cfrac{3^2}{2 + 5^2}}} \ldots\ldots$$

Very recently, an IBM researcher has shown how a general continued-fraction may be reduced to the equivalent unit continued-fraction. This is exciting because the unit fraction is unique for a given set of general fraction. Mr Whiteside's program — written for the TI-59 — is able to convert the 1654 algorithm above to the unique unit continued fraction for pi. After keying in the program, press A to run and the output will be in the form.

3
7
15
1
292

Meaning

$$\pi = 3 + \cfrac{1}{7 + \cfrac{1}{15 + \cfrac{1}{1 + \cfrac{1}{292 \cdots}}}}$$

Hence our calculator will derive π to an arbitrary number of decimal places — well beyond the inherent accuracy of the machine!

Professor Ashworth of London is concerned that we do not give away 'secret' information. He has an interesting idea which is applicable if a calculator is being used for income-tax calculations, home accounts, or any other confidential purpose the stores contain figures one would not wish to be known. It is easy to obtain superficial confidentiality of data held in a home computer by use of a password, although anyone with access to the program tape or disc can find the password because it has to be there to be checked.

There is no such way of protecting data held in the stores of a programmable calculator, although the program itself can be protected from being copied. Anyone with access to a magnetic card on which the data is recorded can read it, and in the case of a constant-memory calculator the stores are openly available.

A simple device will, however, make the records meaningless to other people. At the end of a series of calculations a secret number — such as a previously used telephone number, bank account number, or similarly easily-remembered set of digits — is keyed into the display, made negative, and by means of a short sub-routine, accessed by a user-defined label, this is summed into all the stores. If the number is numerically larger than their contents it drives all of them into a negative condition which gives no idea of their true content. When the calculator is next used the same set of digits, left positive this time, is keyed in and added by the same sub-routine to all the memories to restore them to their correct values.

It will be obvious that a similar ploy could be used equally well, and with more safety than a password offers, to disguise the values stored in the program of a small domestic computer.

The next program from D Darman, of Allington, enables frustrated Casio algebraic notation machine users to convert to reverse Polish notation.

To use the program the keys are given the following meanings:

- P4 — Enter
- P3 — Plus
- P8 — Minus
- P2 — Multiply
- P7 — Divide
- P1 — Pick
- P6 — Roll
- P0 — Mod
- P9 — display top of and, stack.

The keys P3 — plus, P8 — minus, P2 — multiply, and P7 — divide — are the same as the keys +, −, ×, ÷, except that they operate on the top two numbers ;on the stack, for example, to calculate 2+3 you would enter 2, then enter P4 3, then enter P4 + P3 and 5 would be displayed and also put onto the stack.

The mod function P0 converts the number second down on the stack to the modulus of the number on the top of the stack; for example: 9 enter P4, 7 enter P4 mod P0 results in 2 being displayed since 9 mode 7 = 2.

The function Pick — P1 — uses the number on the top of the stack to pick a number down the stack and put it on the top of the stack. For example: 11. Enter P0 22, enter P0 33, enter P0 2, enter P0. Pick P1 results in 11 being put on top of the stack since 11 is the third number down; note that the original 11 is still in the stack beneath 22.

Roll P6 is like pick P1 except that when the number is copied to the top of the stack, the rest of the stack is moved down to fill up the gap, for example, 11; enter 22; enter 33; enter 44; enter 3, enter Roll — P6 — result in the stack changing thus:

from	to
3	22
44	44
33	33
22	11
11	

Rotating the top three numbers on the stack.

Finally, a game for the FX-602p written by Anil Jagota of Newcastle.

This program was originally written for the Casio FX-602p programmable calculator.

To play you press P0 and your total spending money to be displayed. You are allowed to bid anything from 50p up to your total. Press EXE to enter your bid. You are then dealt a card displayed as n:. If you wish to twist press EXE the display then shows n:n:. You are allowed to twist four times giving you a total of five cards. If you wish to stick at any one time you would press P1. The calculator will then check if you have a possible pontoon or if you are bust.

If you have not, the calculator will go ahead and have its own hand of cards. If it beats you or equals you without going bust, the calculator wins and tells you so. It also tells you if you have won. If you lose you lose the amount of money bet.

After the hand of cards the calculator checks if you have less than 50 or more the 10,000 left. If you have less than 50 the game is over for you and the calculator tells you so. If you have more than 10,000 left you have won and the calculator will tell you so.

If your total is between 50 and 10,000 you are dealt another hand of cards and the game continues with a new bet.

To reduce or enlarge the lowest bet allowed go to the WRT mode and STEP 23 on P6 and change the 50 of 50 MINF to whatever you wish. To reduce or enlarge the end of game total go to the WRT mode and STEP 131 and change the 1 EXP 3 which is 10,000 to whatever you wish; EXP need not be used.

Program 2. Mr Darman's program.

```
P0 11 Steps +1
GSB P9, MinF, 1/x, X, GSB P9, =
Frac,
X, MRF, =, GSB P4
P1 9 Steps +1
GSB P9, +/-, +, MR1F, =, Min F,
Ind, MRF, GSB P4
P2 5 Steps +1
GSB P9, X, GSB P9, =, GSB P4
P3 5 Steps+1
GSB P9, +, GSB P9, =, GSB P4
P4 6 Steps+1
IND, Min 1F,x ⇆ y,1, M+1F,x ⇆ y
P6 25 Steps+1
GSB P9, GSB P4, GSB P1, 1, M - 1F,
LBL0, 1, M + F, IND, MRF, x ⇆ y,
1, M - F, x ⇆ y, IND, MINF, 1,
M+F, MR1F, x=F, GOTO9, GOTO0,
LBL9, GSB P9, GSB P4
P7 6 Steps+1
GSB P9, ÷, GSBP9, x ⇆ y, =,
GSB P4
P8 4 Steps+1
GSB P9,+/-, GSB P4, GSB P3
P9 7 Steps+1
MR1F, x=0, 1/x,1, M - 1F, IND, MR
Total 78 + 9 = 87 steps
```

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Snake

K Feary, Wendover, Buckinghamshire.

ZX-81

SNAKE IS FOR an expanded ZX-81, and was inspired by a game which, when reviewed for the BBC Micro, was said to be addictive. The object is to move the snake around the screen so that it can eat plus signs and make its body as long as possible. Any key in the top row will move the snake up. Any key in the bottom row, except Shift, will move it down. Any key on the right of the middle two rows moves it right and any key on the left of the middle two rows moves it left.

Using >,<,A or V the snake's head points in the direction of motion. As it moves more plus signs and obstacles — black squares — appear at random positions. If the head hits an obstacle you must stop pressing the keyboard before changing direction or destroying the obstacle by pressing Shift. If the obstacle does not disappear then you were not trying to move the head into that square and will have to press a key in the direction of the obstacle to be destroyed.

Each obstacle eliminated shortens the snake by one segment. The game ends when the score is zero or when you try to move into a square which has part of the snake's body in one of the four surrounding squares. Each time it moves the characters making up the body are inverted. This gives the illusion of motion and locates the new address of the snake's tail.

The program contains some useful instructions, Exx swaps bc,de,hl for their alternate registers and is shorter and faster than having to Push and Pop all three pairs.

EX (sp),hl

swaps the two bytes at the top of the stack and the contents of hl and saves having to "ld" into a variable. It also demonstrates the use of FD instructions.

These use the iy register which is loaded with 4000h unless you alter it. The bytes after FD are the same as if using hl, except when hl is in brackets, then the third byte must be a displacement measured from iy just like relative jumps. The only exception is

jp(iy)

which would be just FD E9. There are no FD ED instructions nor

ex de,iy

otherwise any instruction using hl will work.

To load the program create Rem lines 1-10, each 43 characters long. Then Poke 16511,230 and Poke 16512,1 to make one long line. Use the often-published hexloader to enter the code, add;

2 RAND USR 16653

and then save before running.

```
4082          disable list        76 76
              SCOR                38 28 34 37
TOP           E:                  2A 0E 00 00
Line                              00 00 00 00
                                  00 00 00 00
                 H                00 00 00 2D
              I-SC                2E 16 38 28
              ORE:                34 37 2A 0E
                                  00 00 00 00
40A4          up,left             FF DF 00 20
Test Str      right,down          00 02 00 20
40AC          GAME                AC A6 B2 AA
Game           OVE                80 B4 BB AA
Over          R                   B7
40B5 #1       bit 0,(L.FRAMES)    FD CB 34 46
              ret z               C8
Test          add a,l             85
Rnd           ret po              E8
              call #2 Rnd         CD C9 40
              ret nz              C0
              ld (hl),128         36 80
              call #2 Rnd         CD C9 40
              ret nz              C0
              ld (hl),21          36 15
              ret                 C9
40C9 #2       ld hl,(SEED)        2A 32 40
     #3       ld de,(HSD LFRM)    ED 5B 33 40
Rnd           add hl,de           19
              ld (SEED),hl        22 32 40
              add a,h             84
              and 31              E6 1F
              cp 23               FE 17
              jr nc #3            30 F1
              inc a               3C
              ld b,a              47
              add a,l             85
              and 31              E6 1F
              ld c,a              4F
              call Print At       CD F5 08
              ld hl,(DF.CC)       2A 0E 40
              ld a,(hl)           7E
              cp 8                FE 08
              ret                 C9
40EB #4       ld a,(SEGS)         3A 40 40
              neg                 ED 44
Dlay          ld b,a              47
     #5       ld c,16             0E 10
     #6       dec c               0D
              jr nz #6            20 FD
              djnz #5             10 F9
              ret                 C9
40F9 #7       ld b,4              06 04
              push hl             E5
Find          ld hl,Test Str      21 A4 40
Segs #8       ld d,(hl)           56
              inc hl              23
              ld e,(hl)           5E
              inc hl              23
              ex (sp),hl          E3
              add hl,de           19
              cp (hl)             BE
              jr z #9             28 03
              ex (sp),hl          E3
              djnz #8             10 F4
     #9       pop de              D1
              ret                 C9
410D          ld de,Top Line      11 84 40
              ld bc,32            01 20 00
              call Print Str      CD 6B 0B
              ld a,32             3E 20
              ld hl,(DF.CC)       2A 0E 40
              inc hl              23
              push hl             E5
              ld c,23             0E 17
     #10      ld b,a              47
     #11      ld (hl),8           36 08
              inc hl              23
              djnz #11            10 FB
              inc hl              23
              dec c               0D
              jr nz #10           20 F6
              ld b,a              47
     #12      ld (hl),a           77
              inc hl              23
              djnz #12            10 FC
              pop hl              E1
              ld bc,3,6           01 06 03
              ld (SEGS),b         FD 70 40
              ld (TAIL),hl        22 3E 40
     #13      ld (hl),c           71
              inc hl              23
              djnz #13            10 FC
              ld (DF.SZ),b        FD 70 22
              ld (HEAD),hl        22 3C 40
              ld (hl),18          36 12
              ld (MV),18          FD 36 42 12
              ld c,29             0E 1D
              call Print At       CD F5 08
              ld c,(HI-SCORE)     FD 4E 7B
              call Print No.      CD 98 0A
     #14      call #15 Play       CD 58 41
              jr #14              18 FB
4158 #15      call #1 Test RND    CD B5 40
     #16      call #4 Dlay        CD EB 40
Play #17      call Kscan          CD BB 02
              ld a,l              7D
              inc l               2C
              jr z #17            28 F9
              rlca                07
              cp 253              FE FD
              jr nc #18           30 10
              cp 247              FE F7
              jr nc #19           30 14
              cp 223              FE DF
              jr nc #20           30 18
     #18      ld bc,38,59         01 3B 26
              ld de,33            11 21 00
              jr #21              18 0E
     #19      ld bc,18,19         01 13 12
              ld de,-1            11 FF FF
              jr #21              18 06
     #20      ld bc,59,38         01 26 3B
              ld de,-33           11 DF FF
     #21      ld a,(MV)           3A 42 40
              cp b                B8
              jr z #16            28 C5
              ld hl,(TAIL)        2A 3E 40
              ld b,(hl)           46
              ld hl,(HEAD)        2A 3C 40
              ld (hl),c           71
              add hl,de           19
              ld a,(hl)           7E
              cp 118              FE 76
              jr z #16            28 B7
              cp 128              FE 80
              jr nz #24           20 1E
              exx                 D9
     #22      call Kscan          CD BB 02
              inc l               2C
              jr nz #22           20 FA
     #23      call Kscan          CD BB 02
              inc h               24
              jr z #23            28 FA
              inc h               24
              jr nz #17           20 A6
              exx                 D9
              ld a,8              3E 08
              ld (hl),a           77
              dec (SEGS)          FD 35 40
              jr z #30            28 57
              call #27            CD FB 41
              jr #26              18 29
     #24      push hl             E5
              ld a,b              78
              exx                 D9
              pop hl              E1
              call #6 Find Seg    CD F9 40
              ld a,b              78
              exx                 D9
              and a               A7
              jr nz #31           20 4D
              ld a,(hl)           7E
              cp 8                FE 08
              jr z #25            28 04
              cp 21               FE 15
              jr nz #16           20 80
     #25      ld (MV),c           FD 71 42
              ld (hl),c           71
              ld (HEAD),hl        22 3C 40
              sbc hl,de           ED 52
              ld (hl),b           70
              cp 21               FE 15
              jr nz #27           20 12
              inc (SEGS)          FD 34 40
              call #28 Chng Seg   CD FF 41
41EF #26      ld bc,0,7           01 07 00
              call Print At       CD F5 08
              ld c,(SEGS)         FD 4E 40
              jp Print No.        C3 98 0A
41FB #27      ld hl,(TAIL)        2A 3E 40
              ld (hl),a           77
41FF #28      ld hl,(HEAD)        2A 3C 40
              ld a,b              78
Chng          xor 128             EE 80
Segs          ld c,a              4F
              ld a,b              78
              exx                 D9
              ld b,(SEGS)         FD 46 40
     #29      exx                 D9
              call #6 Find Segs   CD F9 40
```

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```
      ld (hl),c          71
      exx                D9
      djnz #29           10 F8.
      exx                D9
      ld (TAIL),hl       22 3E 40
      ret                C9
#30   ld hl,(TAIL)       2A 3E 40
      ld (hl),a          77
      call #26           CD EF 41
#31   ld c,(SEGS)        FD 4E 40
      ld a,(HI-SCORE)    3A 7B 40
      cp c               B9
      jr nc #32          30 0F
      ld (HI-SCORE),c    FD 71 7B
      ld b,0             06 00
      push bc            C5
      ld c,29            0E 1D
      call Print At      CD F5 08
      pop bc             C1
      call Print No.     CD 98 0A
#32   ld bc,0,10         01 0A 00
      call Print At      CD F5 08
      ld c,9             0E 09
      ld de,Game Over    11 AC 40
      call Print Str     CD 6B 0B
#33   call Kscan         CD BB 02
      inc l              2C
      jr nz #33          20 FA
      rst 8,$            CF 0D
```

Not centipede

Andrew Weekes,
Truro,
Cornwall.

SPECTRUM

THIS PROGRAM is an entertaining game written for the ZX Spectrum. It is not a version of the popular game of the same name, but it is a completely new game involving manoeuvering a hungry centipede along a tunnel without touching the walls, while eating as many grubs as possible.

The characters used are defined on to the keys Q and P.

Lines	Function
1-40	The introduction
41-48	Defining the graphic characters
70-100	Setting up the screen and variables
110-150	Drawing the tunnel and centipede
155-210	Movement of the display
220-280	Display for losing the game and scoring

The Poke statement — Poke 23692,255 is for Scrolling the screen.

```
   1 FOR x=0 TO 20
  10 PRINT AT 20,0;" CENTIPEDE C
ENTIPEDE CENTIPEDE"
  11 POKE 23692,255: PRINT AT 21
,31;" "
  15 NEXT x
  16 CLS
  20 PRINT : PRINT " © Andrew W
eekes 16.11.82 "
  21 PRINT : PRINT "  INPUT HARD
NESS LEVEL (2-10)"
  22 INPUT h
  23 IF h>10 THEN GO TO 22
  25 PRINT : PRINT : PRINT
  30 PRINT "      PRESS ANY KEY T
O START": PRINT : PRINT
  35 PRINT "     GOBBLE THE GRUBS
 '*'": PRINT : PRINT "    WITHOU
T HITTING THE WALLS": PRINT : PR
INT "    LEFT-'Z'          RIGHT
-'M'"
  40 PAUSE 0
  41 FOR x=0 TO 7: READ d
  42 POKE USR "p"+x,d
  43 NEXT x
  44 DATA BIN 00111100,BIN 10111
101,BIN 01100110,BIN 10100101,BI
N 01100110,BIN 10100101,BIN 0111
1110,BIN 00111100
  45 FOR x=0 TO 7: READ d
  46 POKE USR "q"+x,d
  47 NEXT x
  48 DATA BIN 00011000,BIN 00111
100,BIN 10011001,BIN 01111110,BI
N 00111100,BIN 11111111,BIN 0011
1100,BIN 11011011
  50 OVER 1
  60 LET m=0
  70 LET s=0: LET g=0
  80 BORDER 4: PAPER 5: INK 1
  90 LET p=15
 100 LET a=10: LET b=20
 110 CLS
 120 PRINT AT 20,a;".";AT 20,b;"
."
 125 IF RND>0.9 THEN PRINT AT 20
,a+((b-a)/2);"*"
 130 IF SCREEN$ (15,p)="." THEN
GO TO 220
 131 IF SCREEN$ (16,p)="." THEN
GO TO 220
 132 IF SCREEN$ (15,p)<>" " THEN
 LET g=g+1: BEEP 0.1,0
 135 LET s=s+1
 140 PRINT ; BRIGHT 8;AT 15,p;"0
"
 150 POKE 23692,255: PRINT AT 21
,31;" "
 155 RANDOMIZE : RANDOMIZE
 160 LET m=INT (RND*h)-(h/2)
 161 IF m=0 THEN GO TO 160
 162 LET m=m+RND*2
 170 IF a>=0 THEN LET a=a+m
 175 IF b<=30 THEN LET b=b+m
 180 IF a<=0 THEN LET a=a+ABS (m
): LET b=b+ABS (m)
 185 IF b>=29 THEN LET b=b-ABS (
m): LET a=a-ABS (m)
 190 PRINT AT 15,p;" "
 200 LET p=p-(INKEY$="z")+(INKEY
$="m")
 210 GO TO 120
 220 PRINT ; OVER 0;AT 15,p;"O":
 PRINT AT 15,p; OVER 1;"*": PAUS
E 0: BEEP 0.1,-40: BEEP 0.2,-30:
 BEEP 0.1,50: BEEP 0.3,0: BEEP 0
.5,-40
 230 CLS : FOR p=0 TO 9
 240 PRINT "YOU SNUBBED YOUR NOS
E ON THE            TUNNEL WA
LL"
 250 NEXT p
 251 PAUSE 100
 255 CLS : PRINT : PRINT "     YO
U SCORED ";INT (s/10);" POINTS "
 256 PRINT : PRINT "    YOU ATE
";g;" GRUBS"
 257 PRINT : PRINT "    THAT'S "
;INT ((s/10)+g);" IN TOTAL"
 258 PRINT : PRINT
 260 PRINT "  DO YOU WANT TO PLA
Y AGAIN ?"
 270 PAUSE 0: LET a$=INKEY$: IF
a$<>"y" THEN STOP
 280 RUN
```

Four routines

David Graham,
Richmond,
Surrey.

VIC-20

THIS PROGRAM runs on an unexpanded Vic-20. It will not work on an 8K or 16K expanded Vic as the memory-mapped screen changes location. The program is comprised of four machine-code routines. The character set runs through all 255 characters in the Vic memory, with very fast alternating borders and sound. A text window is left in the middle of the screen so that any Basic print statement can be displayed — line 240.

Screen Clear 1 clears the screen or prints any character over the screen. The subroutine at line 300 changes eight bytes in Screen Clear 1 to make it operate in reverse. Character Set 2 prints the whole character set on the screen instantly. Border L is a simple program that runs through the border colour combination for a white screen. This is done so fast in machine-code that very thin lines of colour are seen around the border.

Lines 30 to 210 Poke the decimal code into memory. Lines 220 to 310 are a small demonstration of the machine code just entered. Notice in line 230 the character in strings represents the F1 key pressed once. The character-set routine can be set to run at varying speeds, the slowest speed takes two minutes 48 seconds and the fastest about 1.8 seconds. To change the speed, Poke 868, X — where X is between 1 and 255. The sound of this routine can also be turned off or lowered by Poke 831,X where X is between 0 and 15.

For the Screen Clear 1 routine the character printed can be altered by Poke 915, X where X

is between 0 and 255 in the Vic Poke tables. The speed at which Screen Clear 1 runs can be altered by Poke 940, X where X is between 1 and 255.

The start and finishing addresses are given in Rem statements, between the data for the routines. If you want to alter something permanently, change the data in the data statements.

This is quite easy. For instance, if you wanted to change 831 in the character set routine, simply count from 828 along to 831 in the data statement — the number should be 15 — and change it to what you want.

If you want to alter something temporarily, Poke it in as a direct statement, then Run the line number in which the routine is called, avoiding Running the whole program. The whole program takes up 1,218 bytes and although the machine code is simple, the program produces some spectacular displays.

```
10 REM(C)1982 D.J.N.G.
20 REM * MACHINE-CODE *
30 FORP1=828TO992:READP2:POKEP1,P2:NEXTP1
40 REM CHARACTER SET.
50 REM (828-957)
60 DATA169,0,162,15,142,14,144,162,0,160,0,153,0,30,153,0,31
70 DATA200,192,242,208,245,201,255,240,60,32,94,3,232,138,76,69,3,72,138,72,152,
72,160
80 DATA10
90 DATA140,232,3,160,47,162,215,142,10,144,142,12,144,232,224,241,208,245,140,15
,144,136
100 DATA192,40,208,235,206,232,3,208,228,162,0,142,10,144,142,12,144,104,168,104
,170,104
110 DATA96
120 REM SCREEN CLEAR1
130 REM (914-957)
140 DATA169,32,160,0,162,241,153,0,30,157,0,31,32,168,3,200,202,192,242,208,241,
96,72,138
150 DATA72,162,1,142,252,3,162,255,202,208,253,206,252,3,208,248,104,170,104,96
160 REM CHARACTER SET2
170 REM (958-971)
180 DATA160,0,169,0,153,242,30,200,152,192,255,208,247,96
190 REM BORDER 1
200 REM (972-992)
210 DATA162,255,142,247,3,162,31,142,15,144,202,224,24,208,248,206,247,3,208,241
,96
220 PRINT"]QQQQQQQQQQQQ        PRESS F1"
230 SYS972:GETA$:IFA$<>"■"THEN230
240 PRINT"]QQQQQQQQQQQQQ- VC20 CHARACTER SET -":SYS828
250 FORT=0TO500:NEXTT
260 PRINT"]":POKE36879,8:POKE915,64:SYS914:GOSUB300:POKE915,32:SYS914
270 POKE915,64:POKE940,10:SYS914:GOSUB300:POKE915,32:SYS914
280 PRINT"]- THE CHARACTER SET -":FORP=0TO400:NEXTP:SYS958
290 FORP=0TO400:NEXTP :GOTO280
300 POKE916,160:POKE917,241:POKE918,162:POKE919,0:POKE929,136:POKE930,232:POKE93
1,224
310 POKE932,242:RETURN
```

Forth draw

Simon Cross,
Ipswich,
Suffolk.

ACE

DRAWING PICTURES on the television screen may not be new but this program is written in Forth to run on the Jupiter Ace so it has a different structure to Basic drawing programs. The program enables straight and diagonal lines to be drawn and rubbed out on the screen.

Load the program from the cassette by entering

"load drawer"

The program may then be run by entering

"drawer"

The keys around the G key control the flashing cursor as shown below.

```
R   T   Y
F   G   H
V   B   N
```

If T, H, B and F are North, East, South and West respectively, then R, Y, N and V are NW, NE, SE and SW. The cursor may be switched between drawing and rubbing out modes by pressing O.

This program uses the plot function on the Ace. This function requires three numbers on the stack, the X co-ordinate, the Y co-ordinate and the Plotting mode. The other words in the program test to see if any of the keys specified have been pressed and alter the values of X, Y, and Colour appropriately. One interesting aspect is the method of testing to see if a key has been pressed and then leaving the result as a flag on the stack. The position of the cursor is then tested to see if movement in the desired direction will take it off the edge of the screen; this result is also saved on the stack. The flags on the stack are then tested using the And function and, if true, then the X and Y co-ordinates are changed accordingly.

```
0 VARIABLE X
0 VARIABLE Y
0 VARIABLE COLOUR
: X+ X @ 1+ X ! ;
: X- X @ 1- X ! ;
: Y+ Y @ 1+ Y ! ;
: Y- Y @ 1- Y ! ;
: UP INKEY 116 = Y @ 45 < AND IF Y+
  THEN ;
: DOWN INKEY 98 = Y @ 0> AND IF Y-
  THEN ;
: RIGHT INKEY 104 = X @ 63< AND IF X+
  THEN ;
: LEFT INKEY 102 = X @ 0> AND IF X-
  THEN ;
: DIAG1 INKEY 114 = X @ 0> Y @ 45 < AND
  AND IF X- Y+ THEN ;
: DIAG2 INKEY 118 = X @ 0> Y @ 0> AND
  AND IF X- Y- THEN ;
: DIAG3 INKEY 121 = X @ 63< Y @ 45 < AND
  AND IF X+ Y+ THEN ;
: DIAG4 INKEY 110 = X @ 63< Y @ 0> AND
  AND IF X+ Y- THEN ;
: CHANGE COLOUR @ IF 0 COLOUR ! ELSE
  1 COLOUR ! THEN ;
: COLOUR? INKEY 48 = IF CHANGE 50 200
  BEEP THEN ;
: INPUT? COLOUR? UP DOWN RIGHT LEFT
  DIAG1 DIAG2 DIAG3 DIAG4 ;
: ZERO CLS 21 Y ! 31 X ! 0 COLOUR ! ;
: DRAW X @ Y @ COLOUR @ PLOT ;
: FLASH CHANGE 250 0 DO LOOP ;
: DRAWER ZERO BEGIN INPUT? DRAW
  FLASH DRAW FLASH 0 UNTIL ;
```

Bat stop

P Johnson,
Blythe Bridge,
Stoke-on-Trent.

DRAGON

HERE IS MY version of Breakout for the Dragon 32. The program enables you to choose whichever keys you want for the bat movement. However, because of the way the Inkey$ function works, once you have pushed the key for right, the bat will move right until you press another key to stop it. The same is true of the left. At first this is difficult to do, but you will improve with practice. Suggested values for the first run are a ball speed of 30 and a bat size of 7. The lower the number you input for speed, the faster the ball will move. The program will work on a colour or black-and-white set.

```
10 '**BREAKOUT**
20 '**<C>1982 BY P.JOHNSON**
30 CLEAR 5000
40 H=500:RW=2:N$="THE COMPUTER"
50 GOTO 1110
60 S=0
70 CLS 1
80 A$="":B$="":C$="":D$=""
90 FORA=1024 TO 1055:POKE A,40:POKE A+448,172:NEXTA
100 FORA=0 TO 30:A$=A$+CHR$(174):B$=B$+CHR$(190):C$=C$+CHR$(254):D$=D$+CHR$(222)
:NEXTA
110 ?@32,A$
120 SOUND 60,1
130 ?@64,B$
140 SOUND 60,1
150 ?@96,C$
160 SOUND 60,1
170 FOR A=1 TO RW:?@96+(A*32),D$:SOUND 89,1:NEXTA
180 PL$="":SC$="":FORC=1 TO SZ:PL$=PL$+CHR$(131):SC$=SC$+" ":NEXT C
190 FORA=1056 TO 1440 STEP 32:POKE A,138:POKE A+31,133:NEXTA
200 POKE 1024,128:POKE 1055,128:POKE 1472,128:POKE 1503,128:POKE 1440,128:POKE 1
471,128
210 BL=1290+RND(10)
220 PL=427
230 V=-31
240 POKE BL,79
250 POKEBL,143
```

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```
260 ?@PL,PL$;
270 IF BL>1408 AND (V=31 OR V=33) THEN BL=BL+32:GOTO 290
280 BL=BL+V
290 IF PEEK(BL)<>143 THEN 430
300 ?@480,"**SCORE=";S;"**";
310 POKE BL,79
320 FORC=0 TO BS:NEXT C
330 T$=INKEY$
340 IF T$="" THEN T$=P$
350 P$=T$
360 IF T$<>RI$ AND T$<>LI$ THEN 250
370 ?@PL,SC$;
380 IF T$=RI$ THEN PL=PL+2
390 IF T$=LI$ THEN PL=PL-2
400 IF PL<417 THEN PL=417
410 IF PL>447-SZ THEN PL=447-SZ
420 GOTO 250
430 A=PEEK(BL):IF A<>172 THEN SOUND 89,1 ELSE SOUND 10,1
440 IF A=128 THEN V=-V:GOTO280
450 IF A=140 THEN RW=RW+1:PLAY"T255V10DEFGABCCBAGFED":GOTO 70
460 IF A=133 THEN 550
470 IF A=138 THEN 530
480 IF A=172 THEN 690
490 IF A<>131 THEN 570
500 '**HIT BALL**
510 IF V=31 THEN V=-33:GOTO 280
520 IF V=33 THEN V=-31:GOTO 280
530 IF V=31 THEN V=33:GOTO 280
540 IF V=-33 THEN V=-31:GOTO 280
550 IF V=33 THEN V=31:GOTO 280
560 IF V=-31 THEN V=-33:GOTO 280
570 '**SCORES**
580 IF A=174 THEN S=S+100
590 IF A=190 THEN S=S+75
600 IF A=254 THEN S=S+50
610 IF A=222 THEN S=S+20*(RW-1)
620 IF V=-33 THEN V=31:GOTO 640
630 IF V=-31 THEN V=33
640 POKE BL,143
650 ST=BL
660 BL=BL+RND(3)-2
670 IF PEEK(BL)=133 OR PEEK(BL)=138 THEN BL=ST
680 GOTO 280
690 ?@359,"PRESS THE '@' KEY";
700 IF INKEY$<>"@" THEN 700
710 CLS1
720 SOUND 89,1
730 IF H>S THEN 900
740 H=S
750 CLS3
760 A$="":FORA=1 TO 32:A$=A$+CHR$(159):NEXTA
770 ?@0,A$;
780 ?@448,A$;
790 ?@32,"********************************"
800 ?@64,"* YOU HAVE GOT THE HIGH SCORE  *"
810 ?@96,"********************************"
820 ?@160,"PLEASE TYPE THE NAME YOU WISH TO"
830 ?@224,"BE KNOWN BY & PRESS THE 'ENTER'"
840 ?@288,"KEY. (MAX.12 LETTERS)."
850 INPUTN$:IF LEN(N$)>12 THEN N$=LEFT$(N$,12)
860 ?@384,"IS THIS CORRECT(Y/N)?"
870 INPUT Y$
880 IF Y$="N" THEN 750
890 IF Y$<>"Y" THEN SOUND 1,1:GOTO 860
900 CLS8
910 A$="":FORA=1 TO 32:A$=A$+CHR$(191):NEXTA
920 ?@0,A$;:?@448,A$;
930 ?@64,"****BREAKOUT BY PAUL JOHNSON****"
940 ?@96,"--------------------------------"
950 A$="                                "
960 P$=(16+LEN(STR$(H)))
970 L$=LEFT$(A$,(32-P)/2)+"**HIGH SCORE "+STR$(H)+" **"
980 ?@160,L$
990 P=14+LEN(N$)
1000 L$=LEFT$(A$,(32-P)/2)+"**HELD BY "+N$+" **"
1010 ?@224,L$
1020 ?@288,"--------------------------------"
1030 ?@352,"THE LAST SCORE WAS";S
1040 ?@416,"PRESS '@' FOR NEXT GAME"
1050 ?@480,"(PRESS 'C' TO ALTER CONTROLS)";
1060 T$=INKEY$
1070 IF T$="C" THEN 1110
1080 IF T$<>"@" THEN 1060
1090 PLAY"T255V10ABABABABABABABABABABABABABAAT6AB"
1100 GOTO 60
1110 CLS
1120 ?@33,"KEY FOR RIGHT";:INPUTRI$
1130 ?@97,"KEY FOR LEFT";:INPUTLI$
1140 ?@161,"BALL SPEED(0-40)";:INPUTBS
1150 IFBS<0 OR BS>40 THEN 1140
1160 ?@256,"BAT SIZE(1-7)";:INPUTSZ
1170 IF SZ<1 OR SZ>7 THEN 1160
1180 GOTO 60
```

Typewriter

David Prideaux,
Crownhill,
Plymouth.

BBC

HERE IS A program which provides the basic facilities of an electronic typewriter for letter-writing, namely continuous-text entry, editing for errors and justification of the right-hand margin.

The printer codes used are for the Epson range of printers: no doubt the procedure ProcMenu could be adapted to suit other printers. In terms of memory requirement the program should run on BBC Model A micros, but for the most effective display mode 0 is used and this demands a Model B.

The program uses a series of procedures, starting with ProcLine which reads characters from the keyboard and puts them into a string A$, until it exceeds the length of a line W. The complete line is then put into an array Print$, while the remainder of A$ goes on to have further text added to it.

Three control characters are entered in the text, cursor right for Newline — line 240 — the Tab key for a new paragraph — line 250 — and Return on completion to process the text — line 200. ProcCheck steps through the entered text in the array, a line at a time, giving options to accept the line, correct it or pad it out to justify the right-hand margin, by adding spaces — ProcPad. Finally, ProcPrint reads the contents of the modified array to the printer.

The test used to recognise the end of a word in the text is by locating spaces. Consequently the neatest effect is achieved by placing punctuation marks immediately after a word, with no intervening space, and always following punctuation marks with a space — except for open quotation marks.

```
   10 REM             **TYPIST**
   20 REM       (c) David Prideaux 1982
   30 *TV255
   40 MODE0
   50 ONERROR GOTO980
   60 VDU19,0,4;0;
   70 PRINT''" FORMAT:"''" A5 : 41 lines, 50 wide.  A4 : 60 lines, 75 wide. (Nor
mal print)"''"                    79 wide.                      (Condensed print)"'
   80 INPUT"Please enter required printing width "W
   90 DIM Print$(60):DIM L(W):lno=1:A$=""
  100 *FX4,1
  110 CLS
  120 PRINT'" Ignore mistakes while typing in your script. "'" Use cursor -> for
 new line, TAB for new paragraph, RETURN when finished."'" Please start typing."

  130 MOVE W*16,1024:DRAW W*16,0
  140 Y=VPOS+2
  150 FOR line=1 TO 60:PROCline:NEXT
  160 END
  170 REM     *PROCEDURES*
  180 DEFPROCline
  190 G=GET:A$=A$+CHR$(G)
  200 IF G<>13 GOTO240
  210 NOL=lno+1
  220 Print$(lno+1)=A$: PROCcheck
  230 PROCprint:END
  240 IF G<>137 GOTO250 ELSE Print$(lno+1)=A$:A$="":lno=lno+1:Y=Y+1
  250 IF G<>9 GOTO260 ELSE Print$(lno+1)=A$:A$="            ":lno=lno+2:Y=Y+2
  260 PRINTTAB(0,Y);A$;TAB(W+2);lno
  270 IF LEN(A$)<=W GOTO190
  280 PRINTTAB(0,Y);SPC(W+1)
  290 MOVE W*16,1024:DRAW W*16,0
  300 lno=lno+1:N=W+1
  310 REPEAT
  320   N=N-1:P$=LEFT$(A$,N)
  330   UNTILASC(MID$(A$,N,1))=32
  340 A$=RIGHT$(A$,LEN(A$)-N)
  350 Print$(lno)=P$
  360 PRINTTAB(0,Y);P$
  370 Y=Y+1:IF Y>22 Y=1
  380 ENDPROC
  390 DEFPROCprint
  400 *FX15,0
  410 *FX4,0
  420 VDU1,27,1,56:REM Cancel paper-out alarm
  430 PRINTTAB(0,NOL+1);"Do you want printer on? (Y/N)":R=GET:CLS:IF R=89 OR R=1
21 PROCmenu:VDU2
  440 MOVE W*16,1024:DRAW W*16,0
  450 FOR N=1TO NOL:PRINTPrint$(N):NEXT:VDU3
  460 VDU1,27,1,70;1,18;1,27,1,87,1,0;1,27,1,72:REM Cancel print options
  470 ENDPROC
  480 DEFPROCcheck
  490 CLS
  500 PRINTTAB(10,0);"Line check"
  510 FOR N=1TO1500:NEXT
  520 FOR N=0TO NOL
  530   MOVE W*16,1024:DRAW W*16,0
  540   PRINTTAB(0,N);Print$(N);TAB(65,0);"Line ";N
  550   PRINTTAB(0,0);"Is line correct? N to edit, SPACE if OK, RETURN to justif
```

```
y."
  560   T=GET:IF T=13 PROCpad:GOTO620
  570   IF T=32 GOTO620.
  580   *FX4,0
  590   VDU11
  600   PRINT"Copy line with correction,then RETURN."!SPC(23):INPUTLINE"" Print$
(N)
  610   N=N-1: PRINTTAB(0,1);SPC(W)
  620   PRINTTAB(0,N);Print$(N);PRINTTAB(0,N+1);Print$(N+1);NEXT
  630 ENDPROC
  640 DEFPROCpad
  650 IF INSTR(Print$(N),"            ")=1 PAR=11 ELSE PAR=1
  660 SP=0:S$=""
  670 FOR S=PAR TO W
  680   IF ASC(MID$(Print$(N),S,1))=32 AND ASC(MID$(Print$(N),S+1,1))=32 S=S+1:G
OTO680
  690   IF ASC(MID$(Print$(N),S,1))=32 SP=SP+1:L(SP)=S:S$=S$+MID$(Print$(N),L(SP
-1)+1,S-L(SP-1)-1)
  700   NEXTS
  710 Print$(N)=""
  720 Y=(W-LEN(S$)-1)DIV(SP-1)
  730 V=(W-LEN(S$)-1)MOD(SP-1)
  740 Y$="":U$=""
  750 FOR R=1 TO Y:Y$=Y$+" ":NEXT
  760 U$=Y$+" "
  770 FOR T=1TOSP
  780   IF T<=V/2 OR T>(SP-1-(V/2)) ADD$=U$ ELSE ADD$=Y$
  790   IF T=SP ADD$=""
  800   Print$(N)=Print$(N)+MID$(S$,L(T-1)-T+2,L(T)-L(T-1)-1)+ADD$
  810   NEXTT
  820 ENDPROC
  830 DEFPROCmenu
  840 CLS
  850 PRINTTAB(10,5);"Select print font: """"" 1 Condensed print""" 2 Normal pri
nt""" 3 Enlarged print"""" 4 Emphasised print""" 5 Doubled print"
  860 font=GET-48:IF font>5 GOTO850
  870 PRINT'" 6 Erase last choices"
  880 PRINT''"You have selected ";font
  890 REM Epson print codes
  900 IF font=1 VDU1,15
  910 IF font=3 VDU1,27,1,87,1,1
  920 IF font=4 VDU1,27,1,69
  930 IF font=5 VDU1,27,1,71

  940 IF font=6 VDU1,27,1,70:1,18:1,27,1,87,1,0:1,27,1,72
  950 PRINT"Do you want another choice? (1-6 or N)";R=GET-48:IF R<7 font=R:GOTO9
80 ELSE IF R<>30 AND R<>62 GOTO950
  960 CLS
  970 ENDPROC
  980 *FX4,0
  990 REPORT:PRINT" AT ";ERL
```

Change goals

George Thordian,
Kidderminster,
Worcestershire.

VIC-20

WRITTEN FOR the unexpanded Vic-20, this program is based on the old pinball game.

Lines 30-100 set up the arrangement of bumpers. These can be moved around according to taste, the ball bouncing off any of these symbols wherever it finds them.

Line 110 sets up the goal to be defended. This too may be extended to add extra difficulty.

Thus we have a game easily changed to produce a new game and reduce the chance of learning the game by rote. Throughout the program square brackets indicate a control key and curly brackets indicate cursor key movements with repetitions.

RHT = RIGHT
LFT = LEFT
UP = UP
DWN = DOWN

Graphic symbols are shown by their shifted key; other keys are shown as on the keyboard.

```
10 ?"[RED][CLR]       PINBALL WIZARD[BLU]{DWN}":GOSUB650
20 F=1:G=1
30 ?"[CLR][YEL]{RHT5}*{DWN2}{LFT2}*{RHT}*";
40 Y=INT(RND(1)*18)
50 IF Y>7 AND Y<11 THEN 40
60 ?"[PUR]{RHT6}{DWN}{SHFTZ}{RHT2}{SHFTZ}{DWN3}{LFT3}{SHFTZ}{RHT2}{SHFTZ}";
70 ?"[YEL]{DWN4}*{DWN2}{LFT}*{DWN2}{LFT}*";
80 ?"[BLK]{LFT6}{UP3}{SHFTU}{SHFTI}{DWN}{LFT2}{SHFTJ}{SHFTK}"
90 ?"[YEL]{DWN5}{RHT4}*{DWN2}*{UP2}*";
100 ?"[PUR]{DWN2}{RHT6}{SHFTZ}{RHT}{UP2}{SHFTZ}{RHT}{UP2}{SHFTZ}"
110 ?"{HME}[RED]{RHT}{DWN8}{SHFTV}{DWN}{LFT}{SHFTV}{DWN}{LFT}{SHFTV}"
120 FOR B=0TO21
130 POKE 38840+B,2
140 POKE 8120+B,119
150 NEXT B
160 REM PLAYERS MOVE
170 POKE 38402+P*22,6
180 POKE 7682+P*22,117
190 GET A$:GOSUB 260
200 IF A$="B"OR A$="Y" THEN 20
210 ?"{HME}[BLK]{DWN21}SCORE="SC:IF A$=""THEN 190
220 POKE 7682+P*22,32
230 IF A$="{DWN}"THEN P=P+1
240 IF A$="{UP}"THEN P=P-1
250 GOTO 160
260 REM BALL MOVES
270 POKE 7680+X+Y*22,32
280 X=X+F:Y=Y+G
290 H=PEEK(7680+X+Y*22)
300 IF H<>32 THEN 360
310 POKE 38400+X+Y*22,5
320 POKE 7680+X+Y*22,81
330 IF X=21 OR X=0 THEN F=-F
340 IF Y=19 OR Y=0 THEN G=-G
350 RETURN
360 IF H=117 THEN F=-F:X=X+F:SC=SC+2:N=190
370 IF H=42 THEN F=-F:X=X+F:SC=SC+20:N=220
380 IF H=90 THEN G=-G:Y=Y+G:SC=SC+10:N=220
390 IF H=73 OR H=74 OR H=75 OR H=85 THEN G=-G:Y=Y+G:SC=SC+50:N=220
400 IF H=86 THEN 440
410 T=50:GOSUB 600
420 GOTO 310
```

(continued on next page)

(continued from previous page)

```
430 REM BALL LOST
440 Q=Q+1:IF Q=5 THEN 510
450 N=129:T=200:GOSUB 600
460 ?"(CLR)(RHT2)(UP2)OOPS!!"
470 ?"[RVS ON](RHT2)(DWN2)BALL "Q"(DWN2)(LFT5)PRESS B"
480 GET A$:IF A$<>"B" THEN 480
490 RETURN
500 REM LAST BALL
510 N=129:T=300:GOSUB 600
520 ?"[RED](CLR)[RVS ON](DWN2)OH DEAR NO MORE BALLS"
530 ?"(DWN2)STILL,"SC"ISN'T BAD":IF SC<HS THEN 560
540 GOSUB 730
550 HS=SC:?"(DWN)YOU'RE THE PINBALL    WIZARD":GOTO 570
560 ?"THE PINBALL WIZARD    SCORED "HS
570 INPUT"(DWN)TRY AGAIN(Y/N)";A$
580 IF A$="Y" THEN SC=0:Q=0:RETURN
590 END
600 V=36878:S=36874
610 POKE V,9
620 POKE S,N
630 FOR M=1 TOT:NEXT M
640 RETURN
650 ?"DEFEND THE CROSSES ON THE LEFT OF THE SCREENFROM THE GREEN BALL"
660 ?"(DWN)CONTROL YOUR BAT BY MEANS OF THE CRSR KEYS"
670 ?"(DWN2)SCORECARD;(DWN)(LFT)[YEL]*[BLU]=10 PTS(DWN)(LFT7)[PUR](SHFTZ)[BLU]=2
0 PTS"
680 ?"[BLK]              (DWN)(LFT2)(SHFTU)(SHFTI)(DWN)(LFT2)(SHFTJ)(SHFTK)[BLU]=50
PTS"
690 ?"EACH TIME YOU BLOCK THE BALL SCORE AN EXTRA 2 PTS"
700 ?"PRESS ANY KEY"
710 GET A$:IF A$="" THEN 710
720 RETURN
730 V=36878
740 RESTORE
750 FOR A=1 TO12
760 READN,T
770 FOR L=1 TON
780 POKE 36874,T
790 POKE V,8
800 NEXT L
810 POKE V,0
820 NEXTA
830 DATA 25,195,25,195,50,209,50,215,25,219,50,219,25,195,25,209,25,209,25,215,2
5,215
840 DATA 50,219
850 RETURN
```

Serpent

N J Page,
Kingston-Upon-Thames,
Surrey.

SPECTRUM

YOU ARE a snake, hungrily scouring the screen for food, which comes in the form of a flashing blue number. Every time you eat a number, you grow by that number of segments, and another one appears somewhere else on the screen. But watch that you don't touch the electrified walls, or go into your own body, or you will die.

You control the head of the snake with the cursor control keys, and the rest of his body will follow. Your score, which is displayed at the end of each game, is based on the number of segments in your body.

If you would like a bit of sound, and do not mind losing some speed, add the following line: 67 BEEP .01,(LEN a$/10)-20

```
1 DATA 60,126,189,189,189,189,126,189
2 FOR f = 0 TO 7:READ t:POKE USR "a" + f,t:NEXT f
3 LET b$ = "8":BORDER 2:PAPER 7:LET c = 0:CLS
5 LET x = 10:LET y = 19:LET a$ = ""
10 FOR f = 10 TO 19:LET a$ = a$ + "10" + STR$ f:PRINT BRIGHT 1;
   INK 0;AT 10,f;"A":NEXT f
20 GOSUB 165
30 LET Z$ = INKEY$:IF Z$ > "4" AND Z$ < "9" THEN LET b$ = Z$
40 LET x = x + (b$ = "6") - (b$ = "7"):LET y = y + (b$ = "8")
   - (b$ = "5")
45 IF ATTR (x,y) = 120 OR x = 22 OR y = 32 THEN GOTO 500
```

```
47 GOSUB 150
50 LET c$ = STR$ x: IF x < 10 THEN LET c$ = " " + STR$ x
55 LET d$ = STR$ y: IF y < 10 THEN LET d$ = " " + STR$ y
60 LET x1 = VAL a$( TO 2): LET y1 = VAL a$(3 TO 4):
   IF ATTR(x1,y1) <> 120 THEN GOTO 62
61 PRINT AT x1,y1;" "
65 PRINT BRIGHT 1;INK 0;AT x,y;"A"
70 LET a$=a$+c$+d$:IF c = 0 THEN LET a$ = a$(5 TO)
75 LET c = c - (c > 0)
100 GOTO 30
150 LET f$ = SCREEN$ (x,y): IF f$ > "9" OR f$ < "1" THEN RETURN
160 LET c = c + VAL f$
163 BEEP .01,0: BEEP 0.01,10: BEEP 0.01,20
165 PRINT FLASH 1;BRIGHT 1;PAPER 4;AT (RND*22)-1,(RND*32)-1;
    INT (RND*9)+1:RETURN
500 LET x = x -(x=22)+(x=-1):LET y = y -(y=32)+(y=-1)
505 PRINT AT x,y;FLASH 1;"A";AT 10,5;"SCORE = ";(LEN a$/4)-10
510 FOR f = 20 TO -50 STEP -5:BEEP 0.02,f:NEXT f
520 FOR f = 1 TO 200:NEXT f
525 IF INKEY$ = "" THEN GOTO 525
530 CLS: GOTO 3
NOTE: The "A" in lines 10, 65 and 505 is obtained when in
      the graphics mode.
```

Sound graph

Christopher Woods,
Sutton Coldfield,
West Midlands.

DRAGON

THIS SHORT program demonstrates how sound can be detected via the cassette port on the Dragon 32. To see it in action, type in the program, run it and then play music through the cassette port as if you were loading a program. You should see an oscilloscope — like graph of the music volume.

For best results the volume level on the cassette recorder should be adjusted so that two sizes of peaks can be seen. The two Peeks 65312 and 65314 detect quiet and loud noise respectively. This idea could be developed into something like a speech-recognition device.

```
10 REM VOLUME GRAPH BY C.WOODS
20 AUDIOON
30 PMODE4:PCLS:SCREEN1,1
40 LINE-(0,180),PRESET
50 FOR X=0 TO 255 STEP 5
60 IF PEEK(65312)=1 THEN Y=180 ELSE Y=100
70 IF PEEK(65314)<>255 THEN Y=20
80 LINE-(X,Y),PSET
90 NEXT X
100 PCLS
110 GOTO 40
```

3D-maze

P J Heslop,
South Shields,
Tyne and Wear.

VIC-20

OWNING A ZX-81 the ground work for this program was done on that computer, but a Pet provided better graphics so 3D-MAZE runs in just over 2K on any Pet. However, it can be converted to the Vic-20. The object of the game is to escape a eight-by-eight maze using perspective diagrams of your current location, which are renewed after every move.

There is a 20-second delay as the computer generates a random maze during which time instructions are displayed. Basically 4 rotates you 90 degrees left; 6 rotates you 90 degrees right, and 8 moves you forward.

The display takes a little getting used to but flats at the appropriate edge of the screen denote a turn. To convert this program for the Vic-20 make the following changes:

```
560 T=SX:Z=SY:L7702:R=7722: D=440
632 T=T+XM:Z=Z+YM:L=L+23:R=R+21:
    D=D-44
9520 FOR H=22 TO D-22 STEP 22:POKE L+H,
103:POKE R+H,101: NEXT H:RETURN
```

5000-6000 the instructions, and 6010-6070 the end display, should be changed as desired and appropriate colours selected by the user.

```
220 GOSUB5000
230 FOR X=1TO8
240 M(1,X)=M(1,X)+8
250 M(8,X)=M(8,X)+2
260 M(X,1)=M(X,1)+1
270 M(X,8)=M(X,8)+4
280 NEXT
290 FORX=1 TO 8
300 FORY=1 TO 8
310 R=M(X,Y):U=2:IFX=1 THEN360
320 A=M(X-1,Y):O=A
330 GOSUB9900
340 IF R(3)=1 THEN R=R+8
360 P=4:IFY=1 THEN 400
370 A=M(X,Y-1):P=A
380 GOSUB 9900
390 IF R(2)=1 THEN R=R+1
400 IF X=8 ORY=8 THEN GOTO 4000
410 S=3:I=0:IF O=0ORP=0OR R=0 THEN S=S-1
420 IF S=2 THEN I=1
430 R=R+INT(RND(TI)*S+1)*2
500 M(X,Y)=R
510 NEXTY
520 NEXTX
540 X=INT(RND(TI)*7+1):M(1,X)=M(1,X)-8
550 SX=INT(RND(TI)*4+3):SY=INT(RND(TI)*4+3)
555 XM=INT(RND(TI)*3-1):YM=0:IFXM=0THEN YM=INT(RND(TI)*2)*2-1
560 LET T=SX:Z=SY:L=32817:R=32837:D=800
```

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```
565 PRINT"J"
570 FORX=1TO8
580 GOSUB 8000
590 GOSUB 9900
600 POKEL,77:POKER,78:POKEL+D,78:POKER+D,77
610 IFR(4)=0THENPOKEL,100:POKEL+D,99
620 IFR(2)=0THENPOKER,100:POKER+D,99
625 GOSUB9520
630 IFR(1)=1THEN 9500
632 T=T+XM:Z=Z+YM:L=L+41:R=R+39:D=D-80
635 IFT>8ORT<1OR Z>8ORZ<1THEN 650
640 NEXT X
650 GETA$:IFA$=""THEN 650
660 IF A$="4" THEN K=-YM:YM=XM:XM=K
670 IF A$="6" THEN K=-XM:XM=YM:YM=K
680 IFA$<>"8"THEN 560
681 T=SX:Z=SY
682 GOSUB 8000
683 IF A<8THEN SX=SX+XM:SY=SY+YM
685 IF SX<1THEN 6010
700 GOTO 560
4000 IF X=1 OR Y=1   THEN 500
4010 A=0:GOSUB9900
4012 IFR(4)=1OR R(3)=1 THEN 500
4020 A=P:GOSUB 9900:IFR(1)=1 OR R(2)=1 THEN 500
4060 IF X=8 THEN4200
4070 R=R+8:M(X-1,Y)=M(X-1,Y)+2:GOTO500
4200 R=R+1:M(X,Y-1)=M(X,Y-1)+4:GOTO500
5000 PRINT"J■■■■■■        3-D MAZE          "
5010 PRINT"■          BY P.HESLOP"
5020 PRINT"■■■■IN THIS GAME,YOU HAVE TO FIND YOUR"
5030 PRINT"■■■WAY OUT OF A MAZE.YOU HAVE 3 CONTROLS:"
5040 PRINT"■■■■ '8' -TO MOVE FORWARD"
5050 PRINT"■■■■ '4' -TO TURN LEFT"
5060 PRINT"■■■■ '6' -TO TURN RIGHT"
5070 PRINT"■■ TO GO BACK,MOVE LEFT TWICE AND MOVE"
5080 PRINT"■■FORWARD."
5090 PRINT "■■■■■■■■■■■■GOOD  LUCK"
6000 RETURN
6010 PRINT"J■■■■■■■■■■■■  ■  ■  ■■■■  ■  ■  ■  ■  ■"
6020 PRINT"■■■■  ■  ■  ■  ■     ■  ■  ■  ■  ■"
6025 PRINT"■■■■  ■  ■■■■  ■■■■  ■  ■  ■  ■  ■"
6030 PRINT"■■■■■■■  ■  ■  ■     ■  ■  ■"
6040 PRINT"■■■■  ■  ■  ■■■■  ■  ■  ■  ■  ■"
6050 PRINT" ■■■■NOW YOU ARE OUT BUT MAY ENTER AGAIN"
6060 PRINT"■■■■■■■■■PRESS 'M' FOR ANOTHER GO"
6070 PRINT"■■■ 'M' FOR MAD,TOTALLY  CRAZY,CRACKED...]"
6080 GET A$:IFA$=""THEN 6080
6090 IFA$="M"THEN RUN
7000 IF A$="N"THEN NEW
7010 GOTO6080
8000 R1=2*XM+ABS(YM):A=M(T,Z)
8010 IFR1=-2THEN RETURN
8020 IFR1=1 AND YM=-1 THENR1=R1+2
8030 FOR M=1 TO R1
8040 A=A*2:IFA>=16 THEN A=A-15
8060 NEXT M
8070 RETURN
9500 FORS=L+1TOR-1:POKES,100:POKES+D,99:NEXT
9510 GOTO 650
9520 FORH=40TOD-40STEP40:POKEL+H,103:POKER+H,101:NEXTH:RETURN
9900 B=8:C=1
9910 R(C)=INT(A/B)
9920 IFA>=BTHEN A=A-B
9930 C=C+1:B=B/2:IFC<>5THEN9910
9940 RETURN
```

Number square

Zui Schreiber,
Goneu,
Israel.

ZX-81

THIS 16K ZX-81 program designs a magic square and prints it on the screen. A magic square is a square of numbers in which the sum of any horizontal vertical or full diagonal line is equal. This program can design one only for an odd width and can show it all on the screen only if its width is less than 10. The program is saved by Run 2 and Run 5000 will allow you to ask for a larger square and print it bit by bit. For a given size the program will always give the same square, but will skip no number between one and the last number and will show no number twice. If a square larger than nine by nine is not demanded, lines 4999 to 6060 are not needed.

```
   1 GOTO 10
   2 SAVE "M■"
   9 REM
  10 REM    ** ZVI SCHREIBER **
  20 REM    ** MAGIC  SQUARE **
  30 REM    ** FEBUARY   1982 **
  31 REM
  35 CLS
  40 PRINT "ENTER SIZE(ODD,N<10)
"
  50 PAUSE 54321
  53 IF INKEY$<"1" OR INKEY$>"9"
 THEN GOTO 50
  56 LET S=VAL INKEY$
  60 IF S/2=INT (S/2) THEN GOTO
50
  62 LET F=1
  70 DIM A(S,S)
  71 GOSUB 75
  72 GOSUB 170
  73 GOTO 4000
  74 REM
  75 REM ** SET UP SCREEN **
  76 REM
  80 CLS
  90 PRINT "HERE IS A ";S;"*";S;
" MAGIC SQUARE,";TAB 0;"THE SUM
OF ANY LINE IS:";(S*S+1)/2*S;"."
 100 LET P1=1
 110 LET P2=S/2+1/2
 120 PRINT AT 2,0;"■■■■■■■■■■■■■■■
■■■■■■■■■■■■■■■■■"( TO S*3+1)
 130 FOR A=1 TO S
 140 PRINT "■  ■  ■  ■  ■  ■  ■  ■
■  ■  ■  ■"( TO S*3+1)
 150 PRINT "■■■■■■■■■■■■■■■■■■■■■■
■■■■■■■■■■■■"( TO S*3+1)
 160 NEXT A
 165 RETURN
 169 REM
 170 REM       ** LOOP **
 171 REM
 180 FOR A=1 TO S*S
 190 LET A(P1,P2)=A
 200 IF F THEN PRINT AT 1+2*P1,-
2+3*P2+(1 AND A<=9);A
 210 IF A=S*S THEN RETURN
 220 IF P1=1 OR P2=S THEN GOTO (
1000 AND P1=1)+(2000 AND P2=S)
 230 IF A(P1-1,P2+1)>0 THEN GOTO
3000
 240 LET P1=P1-1
 250 LET P2=P2+1
 260 NEXT A
1000 LET P1=S
1010 LET P2=P2+1
1020 NEXT A
2000 LET P2=1
2010 LET P1=P1-1
2020 NEXT A
3000 LET P1=P1+1
3010 NEXT A
4000 PRINT AT 21,0;"ANOTHER SQUA
RE? (Y/N)"
4010 PAUSE 54321
4020 IF INKEY$="Y" THEN RUN
4030 GOTO 9999
4999 REM
5000 REM ** START HERE FOR **
5010 REM ** SQUARES LARGER **
5020 REM **     THAN 9*9     **
5021 REM
5025 LET F=0
5030 PRINT "ENTER SIZE OF ANY SI
DE(ODD,<32)"
5040 INPUT S
5050 IF (S-1)/2>INT ((S-1)/2) TH
EN GOTO 5040
5051 DIM A(S,S)
5053 LET P1=1
5056 LET P2=S/2+.5
5060 GOSUB 170
5065 CLS
5070 PRINT "FROM WHICH COLOMN (1
-";S;")?"
5080 INPUT X1
5090 IF X1>INT X1 OR X1<1 OR X1>
S THEN GOTO 5080
5095 CLS
5100 PRINT "UNTILL WHICH COLOMN
(";X1+1;"-";S+(X1+6-S AND X1+6<S
);")?"
5110 INPUT X2
5120 IF X2>INT X2 OR X2<=X1 OR X
2>S THEN GOTO 5110
5130 CLS
5140 PRINT "FROM WHICH ROW (1-";
S-X2+X1;")"
5150 INPUT Y
5160 IF Y>INT Y OR Y<1 OR Y>S-X2
+X1 THEN GOTO 5150
5180 LET S1=X2-X1+1
5190 GOSUB 6000
5200 FOR A=Y TO Y-X1+X2
5210 FOR B=X1 TO X2
5230 PRINT AT 4+(A-Y)*2,1+(B-X1)
*4;A(A,B)
5240 NEXT B
5250 NEXT A
5260 GOTO 4000
6000 CLS
6005 PRINT "HERE ARE COLOMNS NO.
";X1;"-NO.";X2;TAB 0;"AND ROWS N
O.";Y;"-NO.";Y-X1+X2;" OF A";TAB
 0;S;"*";S;" MAGIC SQUARE."
6010 PRINT "■■■■■■■■■■■■■■■■■■■■
■■■■■■■■■■■■■■■■"( TO 1+4*S1)
6020 FOR A=1 TO S1
6030 PRINT "■   ■   ■   ■   ■
■   ■   ■   "( TO 1+4*S1)
6040 PRINT "■■■■■■■■■■■■■■■■■■■■
■■■■■■■■■■■■■■■■"( TO 1+4*S1)
6050 NEXT A
6060 RETURN
9999 STOP
```

Prisms

Andrew Bindon,
Dorchester,
Dorset.'

BBC

WRITTEN FOR the BBC Model B or upgraded A this program requires mode 2 graphics. It is a simple routine designed to draw a prism of any reasonable number of sides and apparently rotate it in three dimensions, with smooth, fast graphics, using the VDU19 command.

The program takes a few seconds to set up, after the initial assignment of the number of sides has been made, during which time it is drawing all the images in background colour.

The number of sides has been restricted to between two and 12, since less than two is silly and more than 12 is virtually circular. With a large number of sides it is best to use a fast rotation. Three to five sides produces best results.

Once the displayed rotation has begun the controls are:—

H : Stops the rotation, which can be continued one frame at a time pressing the space bar — or any other unassigned key. HALT.

N : Returns to normal speed — INKEY$(A) in line 350 acts as a delay, as well as a command control. NORMAL.

I : Causes a single image to be left behind: if held down this causes all images to be displayed. IMAGE.

R : Reverses the direction of the rotation. REVERSE.

F : Increases the speed of rotation. FASTER.

S : Decreases the speed of rotation. SLOWER.

C : Changes the colour of the displayed image restricted to non-flashing colours but this can easily be changed in line 330. COLOUR.

ESCAPE : Restarts the program.

```
10 REM *** ROTATING  PRISMS ***
20 REM *** by Andrew Bindon ***
30 :
40 ON ERROR GOTO 50
50 MODE2
60 REPEAT:INPUT'''"No.of Sides"'" (2-12)",side:CLS
70 UNTIL side>1 AND side<13 AND side=INT(side)
80 :
90 REM MAINLOOP - draws all 15 images of the prism
   in background colour
100 :
110 FOR K%=1 TO 2
120   IF K%=1 VDU29,400;512;ELSE VDU29,880;512;
130   FOR T%=1 TO 15
140     VDU19,T%,0,0,0,0
150     T=T%*PI*2/(side*15)
160     GCOL0,T%
170     MOVE300*COS(T),450*SIN(T)
180     FOR S%=1 TO side
190       S=S%*2*PI/side
200       PLOT29,300*COS(S+T),450*SIN(S+T)
210       IF K%=1 PLOT25,480,0:PLOT24,-480,0
220       NEXT
230     NEXT
240   NEXT
250 :
260 REM ROTATION - turns each image on in succession
    and checks keyboard
270 :
280 K%=0:D=1:A=3:C=7
290 REPEAT
300 K%=K%+D
310 IF K%=0 K%=15
320 IF K%=16 K%=1
```

(continued on next page)

(continued from previous page)

```
330 IF C=8 C=1
340 VDU19,K%,C,0,0,0
350 A$=INKEY$(A)
360 IF A$="H" A=10000:GOTO350
370 IF A$="I" GOTO 430
380 IF A$="R" D=-D
390 IF A$="N" A=3
400 IF A$="C" C=C+1
410 A=A-(A=1)-(A$="S")+(A$="F")
420 VDU19,K%,0,0,0,0
430 UNTIL FALSE
```

Multiplication

L K Fripp,
Yeovil,
Somerset.

SPECTRUM

ON OCCASIONS, accurate multiplication of large numbers is required but the floating-point arithmetic of most home computers is not capable of this. This program overcomes the problem by manipulating the numbers inside strings and will multiply numbers from two-digit length, to lengths bounded only by the capacity of the computer to store the resultant strings.

It operates on the principle of long multiplication, multiplying through A$ by one digit of B$, checking for carries and storing result in C$ — the N loop. Line 150-170 shifts the result left by adding appropriate number of zeros and adds to previous results E$ — after checking their respective lengths line 190 and 200, to decide which routine to use — lines 200-300 or 400-600. It was found quicker to use two routines to cater for unequal length addition thus obviating too many conditional statements.

It then updates E$ line 470 and moves on to multiply by next digit — the M loop.

In present form it only caters for integers but could be amended to cater for decimal point, but I find it quicker to ignore decimal point and insert it manually into the answer.

```
   1 REM FOR MULTIPLYING LARGE I
NTEGERS
   2 REM L.FRIPP © 1982
  20 INPUT "ENTER VALUE TO BE MU
LTIPLIED";A$
  30 INPUT "ENTER VALUE OF MULTI
PLIER";B$
  35 LET A$=B$
  40 LET L=LEN A$: LET K=LEN B$
  50 LET E$="00"
  60 FOR M=0 TO K-1
  70 LET C$="": LET C=0
  80 FOR N=0 TO L-1
  90 LET Z$=STR$ (VAL A$(L-N)*VA
L B$(K-M)+C)
 100 IF LEN Z$>1 THEN LET C$=Z$(
2)+C$: LET C=VAL Z$(1): GO TO 13
0
 110 LET C=0
 120 LET C$=Z$+C$
 130 NEXT N
 140 IF C>0 THEN LET C$=STR$ C+C
$
 150 LET U$=""
 160 FOR T=1 TO M: LET U$=U$+"0"
: NEXT T
 170 LET C$=C$+U$
 180 LET X=LEN C$: LET Y=LEN E$:
 LET R=0
 190 IF X=Y THEN GO TO 400
 200 LET G=X-Y
 210 FOR T=Y TO 1 STEP -1
 220 LET F$=STR$ (VAL C$(T+G)+VA
L E$(T)+R)
 230 IF LEN F$<2 THEN LET R=0
 240 IF LEN F$=2 THEN LET C$(T+G
)=F$(2): LET R=1: GO TO 260
 250 LET C$(T+G)=F$
 260 NEXT T
 270 IF G=2 THEN GO TO 330
 280 LET F$=STR$ (VAL C$(1)+R)
 290 IF LEN F$<2 THEN LET C$(1)=
F$: GO TO 470
 300 LET C$(1)=F$(2)
 310 LET C$="1"+C$
 320 GO TO 470
 330 LET F$=STR$ (VAL C$(2)+R)
 340 IF LEN F$<2 THEN LET C$(2)=
F$: GO TO 470
 350 LET R=1: LET C$(2)=F$(2): G
O TO 280
 400 FOR T=Y TO 1 STEP -1
 410 LET F$=STR$ (VAL C$(T)+VAL
E$(T)+R)
 420 IF LEN F$<2 THEN LET R=0
 430 IF LEN F$=2 THEN LET C$(T)=
F$(2): LET R=1: GO TO 450
 440 LET C$(T)=F$
 450 NEXT T
 460 IF R=1 THEN LET C$="1"+C$
 470 LET E$=C$
 480 NEXT M
 490 PRINT E$
```

Displays

G B Tapp,
Maidstone,
Kent.

SPECTRUM

THIS MACHINE-CODE program allows 48K Spectrum owners to store up to three separate displays, and recall any one of them in a matter of microseconds. Not only can you store the picture but the colour as well. Each picture takes up 6.912K, so with three displays, the user RAM is about 20K.

Type in program 1, making sure that the data is identical, then Run. This Basic program will load the machine code from the data and drop RAMtop to accommodate both the displays and routine.

To store and recall the displays use:

USR 65240 To store the screen to display 1.
USR 65261 To recall display 1 and place it back on screen.
USR 65282 To store the screen to display 2.
USR 65303 To recall display 2 and place it back on screen.
USR 65324 To store the screen to display 3.
USR 65345 To recall display 3 and place it back on screen.

The machine code routine is made up of six similar parts — see the dump — each swaps memory content from one place to another very rapidly.

To see all three displays in action type in the demonstration program, it will draw three pretty pictures, store them, then display each one of them individually.

To save the machine code use:

SAVE"Name" CODE 65240,126

And to load use:

CLEAR 44500: LOAD"" CODE

```
Program 1
  10 REM 3 DISPLAY'S
  20 REM © Gary Bryan Tapp 1982
  30 REM
  40 REM For 48K ZX Spectrum
  50 REM
 100 CLEAR 44500
 110 FOR a=65240 TO 65240+125
 120 READ n
 130 POKE a,n
 140 NEXT a
 145 PRINT "Ready:"
 150 REM **DATA** CHECK IT!
5000 DATA 17,215,227,33,0,64,6,2
7,197,6,0,126,18,19,35,16,249,19
3,16,244,201
5010 DATA 17,0,64,33,215,227,6,2
7,197,6,0,126,18,19,35,16,249,19
3,16,244,201
5020 DATA 17,214,200,33,0,64,6,2
7,197,6,0,126,18,19,35,16,249,19
3,16,244,201
5030 DATA 17,0,64,33,214,200,6,2
7,197,6,0,126,18,19,35,16,249,19
3,16,244,201
5040 DATA 17,213,173,33,0,64,6,2
7,197,6,0,126,18,19,35,16,249,19
3,16,244,201
5050 DATA 17,0,64,33,213,173,6,2
7,197,6,0,126,18,19,35,16,249,19
3,16,244,201
```

```
Demo
  10 REM Demonstration G.B.Tapp
  20 REM
  30 REM Draw Display 1
  32 OVER 1
  34 INK 2
  36 IF PEEK 65240<>17 THEN PRIN
T "Machine Code Not loaded": STO
P
  40 FOR a=1 TO 175
  50 PLOT 0,a: DRAW 255,175-2*a
  60 NEXT a
  70 FOR a=1 TO 255
  80 PLOT a,0: DRAW 255-2*a,175
  90 NEXT a
 100 LET l=USR 65240: REM Save
Display 1
 110 CLS : OVER 0
 120 FOR a=1 TO 75 STEP 8
 130 INK RND*6
 140 CIRCLE 100,100,a
 150 NEXT a
 160 LET l=USR 65282: REM save
Display 2
 170 CLS
 180 FOR a=1 TO 704
 190 PAPER RND*7
 195 INK RND*7
 200 PRINT "*";
 210 NEXT a
 220 LET l=USR 65324: REM Save
Display 3
 230 CLS
 240 REM Call up all 3 Displays
 250 LET l=USR 65261: REM Dis 1
 255 PAUSE 10
 260 LET l=USR 65303: REM Dis 2
 265 PAUSE 10
 270 LET l=USR 65345: REM Dis 3
 275 PAUSE 10
 280 GO TO 250
```

```
Dump
Mnemonics    Comments

LD DE.NN..Address to put display
LD HL.NN..Address to get display
LD B.27...Big Loop
PUSH BC...Store B
LD B,0....Small Loop
LD A,(HL).}
LD (DE),A.} To swap Dis with Mem
INC DE....}
INC HL....}
DJNZ,-7...Jump back 7 bytes
POP BC....Bring back B
DJNZ,-12..Jump back 12 bytes
RET.......Return to BASIC
```

Maze chase

C L Naylar,
BFPO Ships,
London.

ZX-81

IN THIS GAME a randomly-constructed maze is drawn on the screen: you — a plus sign — are placed in the bottom right-hand corner and the bug — represented by an asterisk — the bottom left. An H in the top line represents home and the initial object of the game is to get home before the bug does. After the maze is produced you have time to assess the situation and plan your route. When you are ready, press Shift, and the bug will start off and begin to find its own way home.

By using the keyboard — top line for up, bottom line for down and the left and right sides of the centre lines for left and right respectively — you must get home before the bug. If he catches you, the game ends with your score displayed at the bottom left of the maze. If you manage to get home first then your score is held, you are both reverted to your start positions and on pressing Shift you are off again — this time at a slightly higher speed. After some practice you can get through the maze about five times before the speed becomes too much and the bug eventually traps you.

An additional feature is that if you get stuck in an impossible situation then it is worth driving straight at the bug. Being aggressive like this earns you a random chance of one of two things happening — either the game stops, or if you are lucky you are reverted back to start again with your score so far intact.

As regards loading, in line 1 you need a 345-character Rem statement and then a hex loader as in figure 2. Run this program and enter the hex machine code in figure 1 either

byte by byte or a whole string of them at once — check with the addresses as you go and all should be well.

Next, Save the program before you Run it. Now overwrite line 10 with 10 Rand Usr 16851 and delete the remainder of the hex loader.

Now you may run the program, hopefully it should work, but if not, you may use the program in Figure 3 to check the machine code.

```
16514 0615        D7              19             FE80           09             111600          C1
      3E80  16558 0D              0610           2002           7E             181C            2A7B40
      D7          2809            3680           3E9C           FE15           7D              3615
      10FD        10FA            23             3C             28F1           E618            C3FA40
      3E76        3E80            10FB           FEA6           FE80     16755 2805            C1
      D7          D7              2A0C40         2005           2012           11EAFF          160A
      1609        0D              110B00         369C           79             1812            3695
      3E80        2802            19             2B             FEFF           7D              010005
      D7          18E8            362D           18EF     16711 2802           E660            0B
      0613        3E80            010100         77             1806           2805            78
      3E00        D7        16624 C5             AF             0600           110100          B1
      D7          3E76            CDBB02   16668 2A2140         0E01           1808      16821 20FB
      10FD        D7              7C             3600           1804           7D              7E
16536 3E80        15              FEFE           111600         06FF           E606            FE95
      D7          20CA            20F8           ED52           0EFF           2818            20F1
      3E76  16580 2A0C40          C1             7E             09       16777 11FFFF          362D
      D7          117801          210014         FE2D           222140         00              15
      0E13        19              2B             2003           3617           2A7B40          2802
      3E80        222140          7C             3697           2A7B40         19              18EC
      D7          3617            B5             C9       16734 3600           7E              2AFC40
      3A3440      111200          20FB           FE15           C5             FE2D            2B
      E605        19              2A0C40         2003           CDBB02         2814            2B
      C606        227B40    16645 119001   16690 3608           7D             FE17            22FC40
      47          3615            19             C9             2F             2810      16843 2A2140
      3E80  16601 110700          7E             FE80           6F             FE80            3600
                                                 201D           E681           2803            C3C440
                                                 19             2805     16798 227B40          3E1E
                                                                                               32FC40
                                                                                               C38240
```

```
1 REM .......(345 '0's)......
10 LET X = 16514
20 LET A$ = ""
30 IF A$ = "" THEN INPUT A$
40 IF A$ = "S" THEN STOP
50 POKE X,16*CODE A$ + CODE A$(2) - 476
60 PRINT AT 0,0; X; " 2 spaces "; A$(1 TO 2)
70 LET X = X + 1
80 LET A$ = A$( 3 TO )
90 GOTO 30
```

Figure 2.

```
10 PRINT "ADDRESS?"
20 INPUT A
30 PRINT A; "2 SPACES";
   CHR$ INT(PEEK A/16 + 28);
   CHR$(PEEK A- INT(PEEK A/16) * 16+28)
40 LET A = A + 1
50 GOTO 20
```

Figure 3.

Code invert

Steve Brown,
Camberley,
Surrey.

ATARI

HERE IS A machine-code invert for the Atari 400 computer. This will invert the high resolution in modes 8-11. Not only all the colours are inverted, but also all levels of brightness. The program is not instant because it has to work through nearly 9K of memory. It is located in an area of free RAM and can be called with a C=USR(1536).

```
5 REM + + + + +BY STEVE K BROWN
1982+ + + +
10 DATA 162,33,134,213,169,80,133,212,202,
160,0,177,212,73,255
20 DATA 145,212,200,208,247,230,213,224,3,
208,238,104,96
30 FOR T=1536 TO 1535+28
40 READ D
50 POKE T,D
60 NEXT T
70 GRAPHICS 11
80 FOR F= 1 TO 10
90 COLOR RND(1)*15
100 DRAWTO RND(1)*319,RND(2)*120
110 NEXT F
120 FOR T=1 TO 1000:NEXT T
130 C=USR(1536)
140 GOTO 120
```

Rhythm band

Jason Judge,
Cheltenham,
Gloucestershire.

ZX-81

DESIGNED AS A rhythm generator for the 1K or 16K ZX-81, this uses a machine-code subroutine to put the sounds out through the Mic port.

When the program is run, the tempo has to be entered — 20 is a good start. When this has been done, the screen will be blank.

Press Fast — shifted F — and you will hear a bass drum. This will repeat itself at regular intervals. Now press shifted P, and a woodblock will be added to the bass drum. Press Newline and the tones will be deleted.

Shifted M will allow you to enter new speed and shifted . will allow you to enter a rhythm as a string. By entering graphics, keywords and "+CRH$(X)+" you have 4.72236×10^{21} different rhythms at your disposal.

To enter the program, first Enter and Run program A. Enter the machine data then delete lines 2-70 and enter program B. Save the program then run it. ■

```
   0 REM " RNDR GOSUB PIK CLS
TAN  COPY      GOSUB 7 RND FAST
 PEEK COPY LN  RND<= RETURN LN
RND LPRINT  GOSUB ?K LOAD TAN
  10 FAST
  20 DIM M$(16)
  30 INPUT I
  40 GOTO 110
  50 LET B$=M$(X)
  60 IF B$="" OR B$=" " THEN RET
URN
  70 LET B=CODE B$
  80 IF CODE B$>5 THEN POKE 1651
4,CODE B$
  90 RAND USR 16525
 100 RETURN
 110 FOR X=1 TO 16
 120 IF INKEY$<>"" THEN LET M$(X
)=INKEY$
 130 IF CODE INKEY$=118 THEN LET
 M$(X)=" "
 140 IF INKEY$="," THEN GOTO 210
 150 IF INKEY$=";" THEN GOTO 30
 160 GOSUB 050
 170 FOR T=1 TO I
 180 NEXT T
 190 NEXT X
 200 GOTO 110
 210 INPUT M$
 220 GOTO 110
```

```
   1 REM 0000000000000000000000000
00000000000000000
   2 REM LINE "1" CONTAINS 39 ZE
ROS
   3 POKE 16510,0
   4 REM LINE "3" POKES LINE "1"
 TO "0"
  10 LET A$=""
  20 FOR X=16514 TO 16552
  30 IF A$="" THEN INPUT A$
  40 POKE X,16*COD  A$+CODE A$(2
)-476
  50 LET A$=A$(3 TO )
  60 NEXT X
  70 PRINT "DELETE LINES 2-70 TH
EN TYPE IN  THE SECOND HALF OF T
HE PROGRAM"


FROM ADRESS 16514:

01  00  2A  82  40  37  ED  42
30  FB  C9  21  FF  00  01  00
00  ED  5B  82  40  E5  D3  FF
CD  84  40  D8  FE  CD  84  40
E1  B7  ED  52  30  EF  C9
```

COMPETITION CORNER

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in February. The name of the winner, the solution, and a competition report will be published in the April, 1983 issue of *Your Computer*.

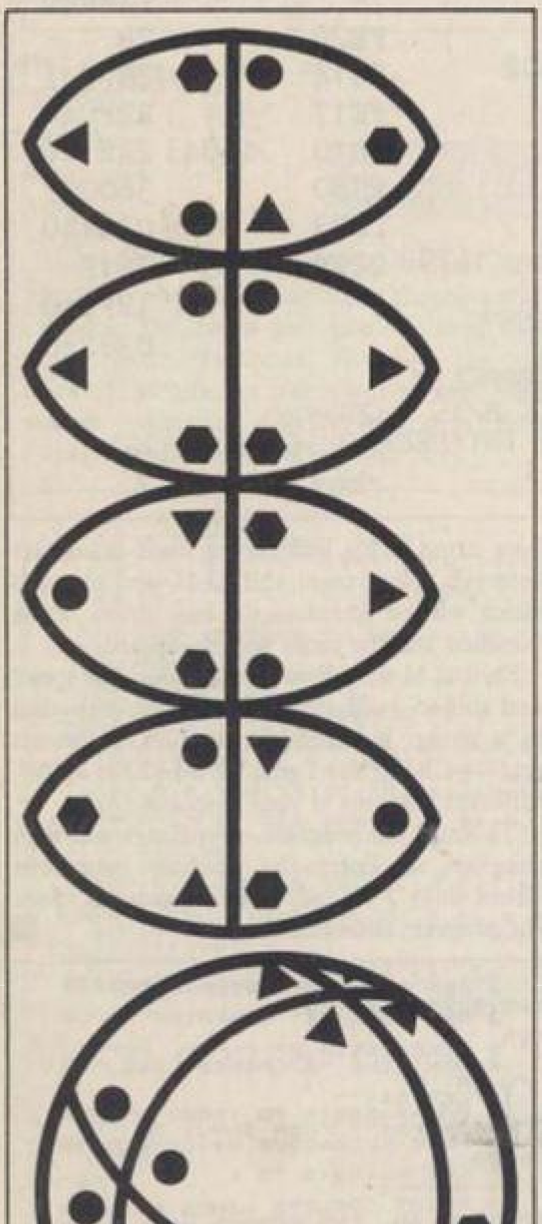
If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

ORB BOMB

BY ANTHONY ROBERTS

YOU ARE in danger of sudden death — floating in through the open window has come this Klingon para-explosive homing anti-personnel mine. It is an orb split into eight segments along three mutually-perpendicular planes meeting at the sphere's centre — so that each hemisphere can be twisted through 90° rather like a spherical Rubik cube. Each segment has a symbol in each corner, and the sphere is defused when all the corners with similar symbols lie together.

A flattened plan of the sphere is shown below: what is the minimum number of 90° twists needed to defuse the mine?



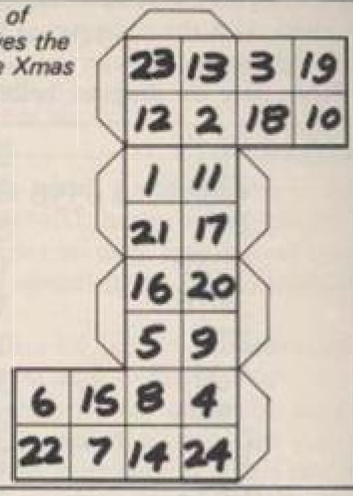
Competition results

OUR CHRISTMAS MAILBAG brought nearly 1,000 entries for the December competition which offered an Atari 400 as a prize. Obviously the Atari is the dark horse in the home computer stakes.

We asked competitors to complete the sentence "An Atari in my Christmas stocking would mean . . .". The winning entry came from Mrs D M Thomson, 55 Kent Avenue, Yate, Bristol, who suggested it would mean "a pleasant piece of hardware in my software". Another entry which indicated that the Atari has a strong appeal for lady computerniks was Mrs Allemand's "my ship had come in because all the nice girls love Atari".

Taking a strictly practical view of this yuletide possibility G Clow wrote "I would not be able to put my foot in it"; a consideration that was echoed by H Barnes' "less room for the Cray 1 I asked for". A Storey expressed the problem neatly with his "a hole in mum's micromesh tights".

The sequence of letters that gives the solution to the Xmas Box problem.

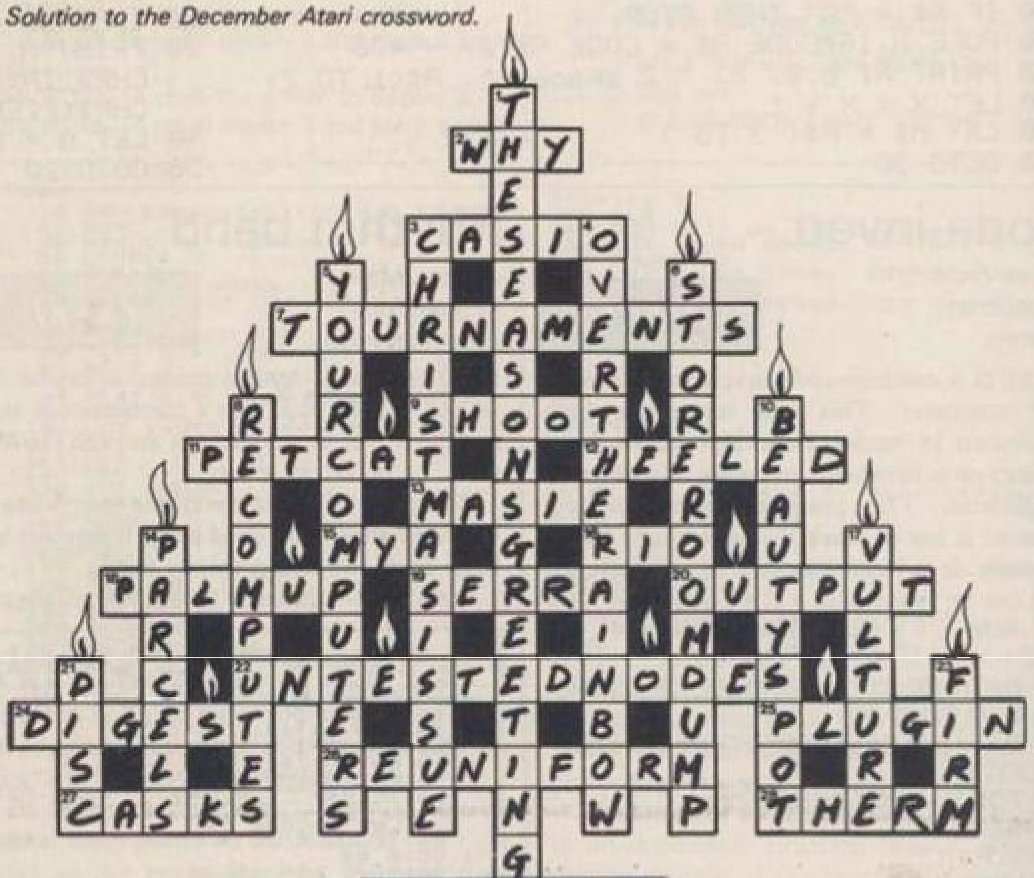


Other entries struck a topical note. S Wallis thought that an Atari in his stocking would have meant that breakfast TV started on the 25th of December and K Parker claimed "that Channel Four would lose 25 percent of its audience"; while M Trezza safely assumed that we watched the ads with "Father Christmas has short fat hairy legs".

There was not much scope for the dedicated punster although J Shaw's "many absorbing hours of explorAtari fun and games" made a valiant effort and several entries looked forward to "Atarific Christmas".

"Have a happy Xmas and New Year" was the startling solution to the Xmas Box problem. Most people found that the problem was not taxing enough to warrant a computer solution. The £15 book program goes to P Topping, 100 Longhill Road, Ovington, Brighton, Sussex, whose entry was the first one we pulled out of the bag. ■

Solution to the December Atari crossword.



VIC-20 and Commodore 64 from Kobra

VIC 20



£129·99
inc VAT – carriage free

Still unbeatable value at this price with a full size keyboard
Backed by Adda's full one year warranty.

Features include: * 5K RAM expandable up to 29K * 8 border colours, 16 screen colours * 8 screen character colours * 3 audible tone generators, each of 3 octaves * a 'white noise' generator * 88 character program line length * 64 ASCII character set * full PET-type graphics character set generated directly from keyboard * 176 × 158 pixels (27,808 in total) maximum resolution * 8 programmable special functions accessed via 4 special function keys.

COMMODORE 64



£343·85
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The 64K personal computer that outpaces the rest
Backed by Adda's full one year warranty.

Features include: * 64K built in RAM * 40 column colour display – tv interface * Upper and lower case characters and graphics * Sprite graphics on eight levels * Music synthesiser with three voices and nine octave range * 16 colours available simultaneously * 8 bit parallel user port.

PRINTER

£230
inc VAT – carriage free

The VIC Printer – suitable for the Commodore 64 also – will print programs, letters, business data and graphics. It offers high specifications at a competitive price.

Features include: 80 characters per line. Tractor feed dot matrix. 30 characters per second print speed. Full alphanumerics and graphic printing. Double-size character capability. Price includes all cables. Alternative printer **GP100VC** with full-size paper feed **£270.25** inc VAT.



DISK UNIT 1541

£299·95
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For the VIC-20 and the Commodore 64.
A disk unit transforms your computer into a high-speed system ideal for the more serious programmer or small businessman. It enables you to get the best out of your utility programs.



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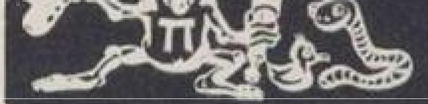
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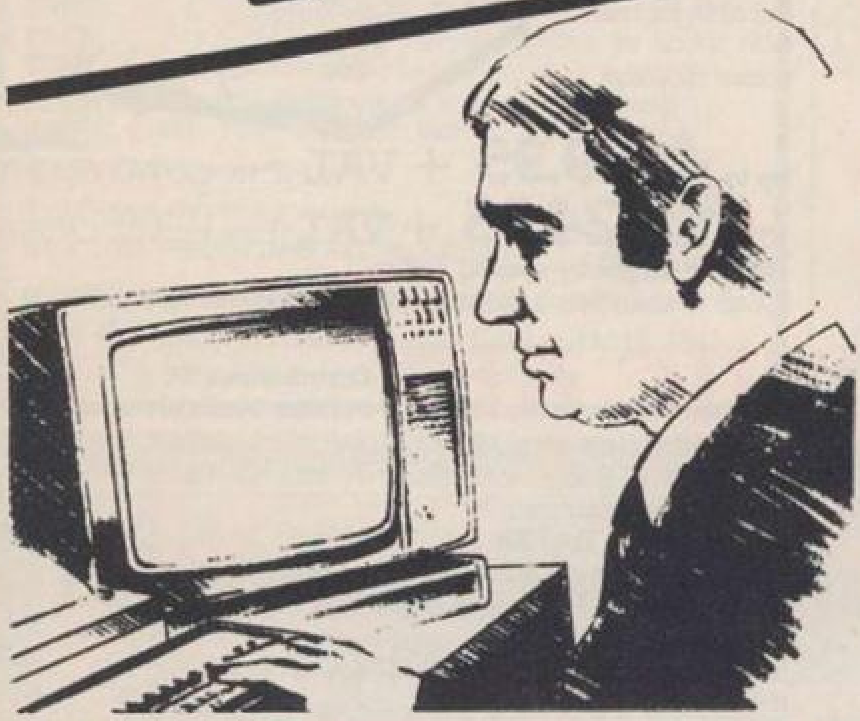
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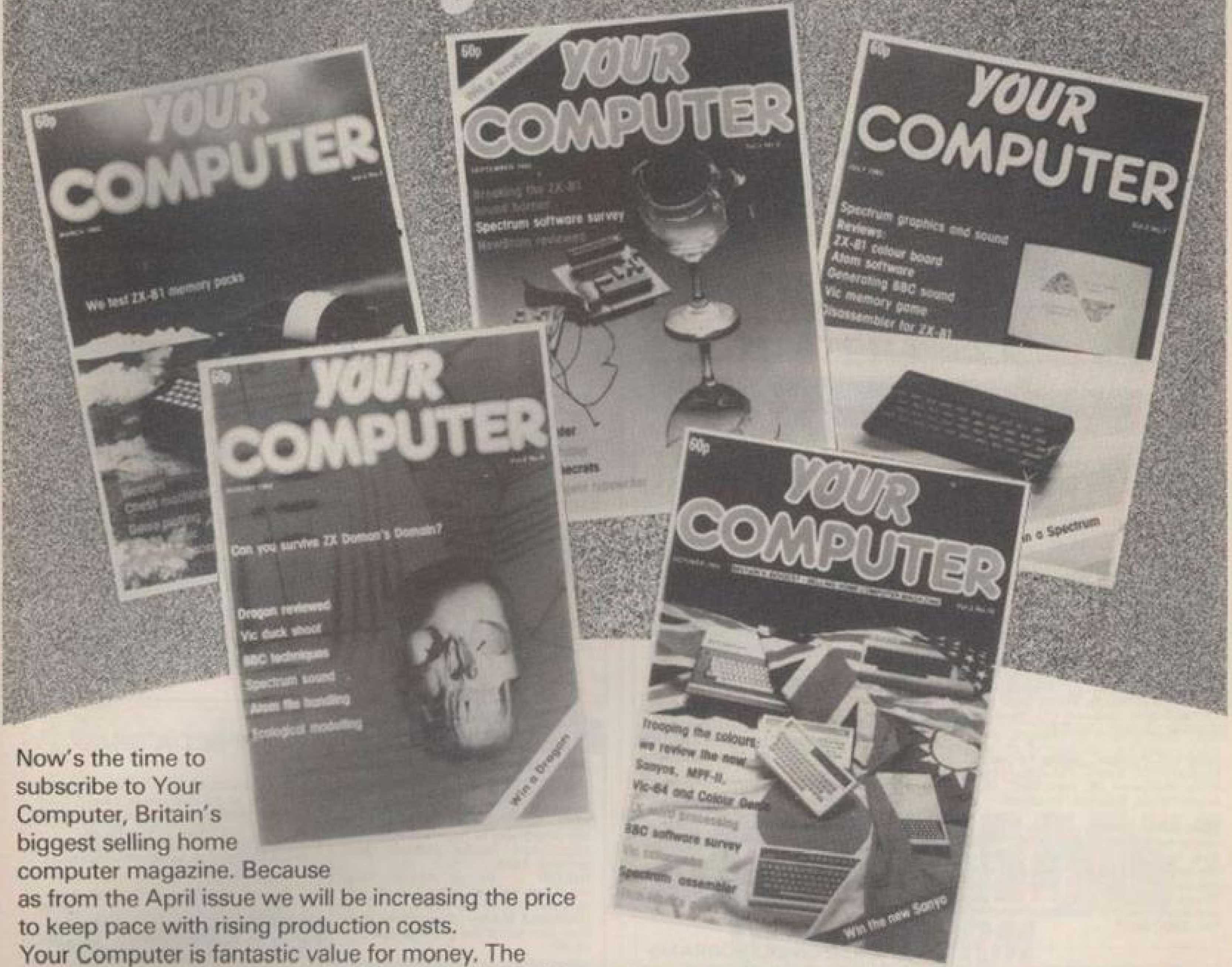
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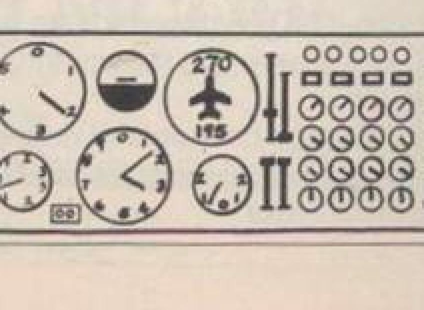
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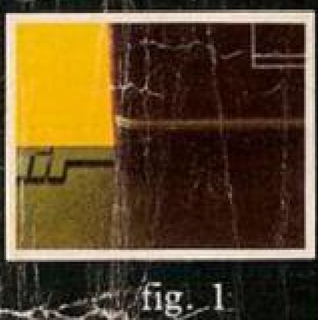


fig. 1



fig. 2

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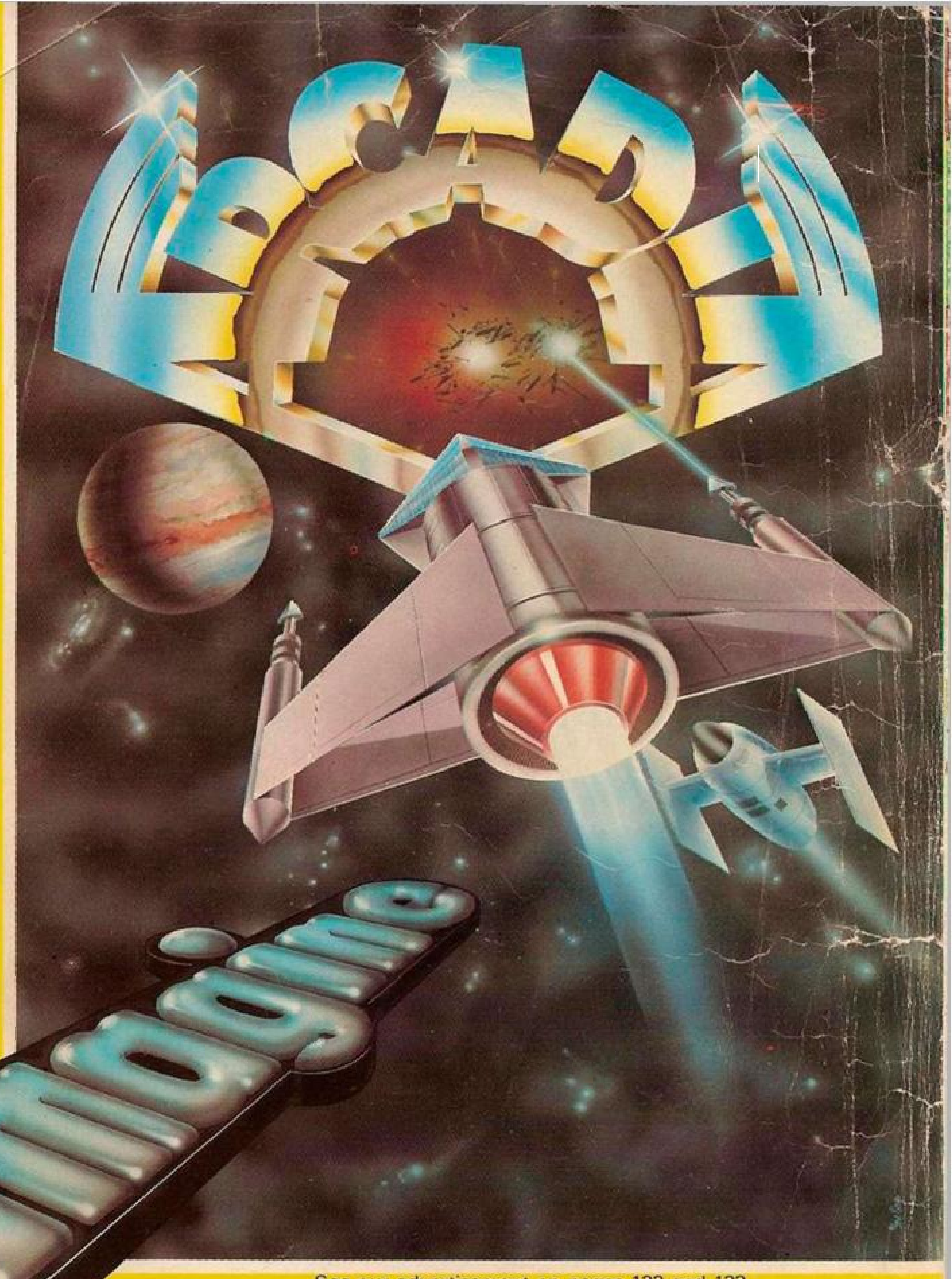
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